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

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Abstract

The cotton revolution (1300-1840 AD) in imperial China constituted a substantial shock to the value of women's work. Using historical gazetteers, I exploit variation in cotton textile production across 1,489 counties and establish a robust negative relationship between high-value work opportunities for women in the past and sex ratio at birth in 2000. To overcome potential endogeneity in location, I use an instrument pertaining to suitability for cotton weaving. I find evidence that premodern cotton textile production permanently changed cultural beliefs about women's worth, and that its effects have persisted beyond 1840 and endured under various political and economic regimes.

Keywords: Culture, historical persistence, high-value work, gender bias
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I Introduction

In most societies throughout history, men have played a dominant role in economics, politics and social affairs. Women's entry into positions of authority in political life, elite educational establishments and major companies has been a recent phenomenon; and in most countries these positions are still overwhelmingly held by men. In the past forty years, despite the increasing participation of women in the workforce, remaining gender gaps in the labor market appear remarkably persistent despite the convergence of other measures of gender equality (Olivetti and Petrongolo, 2016), which suggests a possible role of an underlying gender bias.

The ideal of a dominant man, or men occupying a superior position to women, is seen in various aspects of life. Fisman et al. (2006) observe that men do not appreciate women's intelligence or ambition if it exceeds their own. Bertrand, Kamenica, and Pan (2015) document the presence of a gender identity norm that the husband earns more than the wife and its effects. Violations of this gender identity norm can affect the chance of marriage, happiness of a married couple, as well as induce divorce.

Philosophers, anthropologists and evolutionary biologists have put forward a number of hypotheses concerning the origins of the dominant role of men in society.[1] The dominant role of men in past societies could have given rise to the cultural belief that women are less able than men, and hence, worth less. In the sociological literature, the "devaluation hypothesis" has emerged to explain the wage gap, i.e. when a job is done primarily by women, people tend to believe it has less value (England, 1992).[2] Leslie et al. (2015) find that women are less represented in fields where raw innate talent is seen as important. Recent work in economics lends support to the presence of the cultural belief that women are less able than men: Sarsons (2015) finds that women are perceived to contribute less to group work.[3]

I formulate the hypothesis that the cultural belief that women are worth *less* than men is deeply rooted in their relatively low contribution to economic production in premodern times, and that when women's contribution to economic production becomes close to or above that of men, these beliefs can be transformed. Anthropologist Marvin Harris postulates that

[1] Those hypotheses range from a man's desire to control and impregnate women (Lerner, 1986; Smuts, 1995) to economic and ecological stress giving rise to male dominance (Friedl, 1975). Martin and Voorhies (1975) believe matrilineal systems are adaptive in peaceful environments. Ortner (1981), Sanday (1981) and Tiger (1971) also shed light on the origin of male dominance. For a collection of essays on this topic, see Rosaldo, Lamphere, and Bamberger, 1974.

[2] Psychologists have noticed that both men and women tend to assign more worth and prestige to work performed by men (Deaux, 1985). A number of experiments reveal a tendency for both men and women to hold subconscious biases that devalue the work of women (Knobloch-Westerwick, Glynn, and Huge, 2013; Moss-Racusin et al., 2012).

[3] For a survey on experimental research on labor market discrimination, see Neumark (2016).

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.

The cotton revolution was a substantial shock to the value of women's work. It took place in a highly uniform political and economic environment. The cotton textile boom resulted in a substantial increase in the economic earning power of women in regions that were suitable for the production of cotton textiles: it boosted women's incomes to a level comparable or greater than those of their husbands.[4] The adoption of new spinning and weaving technologies led to the production and market exchange of cotton textiles on a large scale. During this period, China accounted for one-third of the world's population and one-third to one-half of world GDP and had a relatively well-integrated national and regional market economy (Shiue and Keller, 2007). By 1840, as much as 94,553,000 *tael* worth of cotton textiles were traded on the market every year, accounting for 24.4% of the domestic trade.[5] Before mechanized cotton textiles flooded into the Chinese market in 1840, women produced cotton textiles at home, and sold them to local, regional and national markets, which resulted in a "Golden Age" for female incomes.

Before 1300, China had conservative gender norms that resembled those in many agricultural, patriarchal societies. It relied on political and legal institutions based on Confucianism. The Confucian tradition strongly disfavored women.[6] The cotton revolution changed the relative payoffs of taking actions in accordance with beliefs about female inferiority. In models of cultural evolution, in the long run, the choice of behavioral rules has to be consistent with relative payoffs of cultural traits (Boyd and Richerson, 1985). And, as theorized by Bisin and Verdier (2001), the news norms and beliefs about women that arose in textile-suitable areas could have been passed down from generation to generation to today.

To estimate the effects of the cotton revolution on cultural beliefs about women's worth, 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 premodern cotton textiles at a county level for the period of 1300 to 1840. My main sample comprises

[4]An optimistic estimate in Pomeranz's 2002 work suggests that a woman who weaved could earn four times as much as a man.

[5] Table A.XVI shows a breakdown of trading goods just before 1840. Cotton textiles were the most traded textiles at the time. The total value of trade of cotton textiles is second only to that of grain.

[6]See Appendix F.4 for more details on Confucianism and women.

a total of 1,489 counties. I link this data to my main outcome variable: sex ratio at birth, an objective measure of cultural beliefs about women's worth. Examining variation across counties and individuals, I find a strong negative relationship between premodern cotton textiles and sex ratio at birth. The baseline estimates suggest that premodern cotton textile production is associated with a reduction of 3.7 boys per 100 girls in sex ratio at birth, or a quarter of its standard deviation.

The main outcome I examine—sex ratio at birth in 2000—is well suited for the purpose of examining cultural beliefs about women's worth. The one-child policy set a strict fertility constraint and induced widespread sex selective abortion. When children are chosen on the basis of their sex, such selection reflect deeply held cultural beliefs about the relative worth of men and women.[7] If females are deemed to be worth less than males, the sex ratio at birth can in theory reach 200 boys versus 0 girls.[8] Around the globe, legal and moral forces are often important constraints on the use of sex selection to choose the gender of a newborn in a way consistent with underlying beliefs about women's worth; such constraints are not equally present in China.[9] In the 1990s, as ultrasound screening became widespread, another crucial constraint on sex selection was removed (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 cultural beliefs about women's worth were uninhibitedly translated into sex ratio at birth.[10] This motivates the use of sex ratio at birth in 2000 as a main proxy for cultural beliefs about women's worth.

To ensure that my results are not driven by systematic differences between counties with and without premodern cotton textiles, I use matched samples, cluster standard errors on different geographic units, address biases in gazetteer data, employ different subsamples and alternative outcome variables and 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 root causes of gender inequality. Finally, I include one of the most stringent controls—language group fixed effects—to only use variation within popula-

[7] The President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavior Research of the United States observes that the core reason for parents choosing to have boys over girls is the assignment of different values to different genders.

[8] This is unlikely in the long run because the population will not reproduce at that level of sex selection, especially since in practice sex selection is often heavily regulated by legal and moral forces, such as the prohibition of destroying any forms of human life.

[9] 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.

[10] After 2000, there was some relaxation in the enforcement of the one-child policy at a regional level.

tions speaking the same language, and my results remain.

I also compare cotton textile production with lower-value economic activities for women, such as cotton cultivation, tea production, rice production and the production of other textiles. I find that only cotton textile production reduces sex ratio at birth. This suggests that the cultural belief that women are worth less than men likely only changes when the value of women's work reaches a sufficiently high level. There appears to be a discontinuity in the correspondence between the value of women's work and cultural beliefs about their worth. And in any case, women's participation in work alone does not seem to be a sufficient explanation for the observed relationship between premodern cotton textile production and sex ratio at birth.

To note, China went through a series of political and economic changes from 1840 to now. Many of those shocks had a profound impact on economy and society. When I account for intermediate shocks, reassuringly, neither early industrialization, missionary activities, nor recent economic liberalization can explain away the effects of premodern cotton textile production.

My results are robust to an instrumental variable approach. 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 usually between 60% and 85%.[11] Within this range, tensile strength increases in relative humidity (Lewis, 1913; Iqbal et al., 2012). I take the distance between actual humidity and optimal humidity at a monthly level, and aggregate those values over months to form a humidity-for-weaving index. Because relative humidity might affect cultural beliefs about women's worth 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 even closer estimate, which offers further assurance that these coefficients can be causally interpreted.

Next, I provide further evidence on the shift in values due to premodern cotton textile production using subjective measures of gender bias. I show that people from places with

[11] 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). 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).

premodern cotton textile production have less gender bias. I then depict initial changes in cultural beliefs about women's worth following the cotton revolution. Using data collected from historical gazetteers, I find evidence that cotton textile production prevented widow suicide in the Ming Dynasty (1368-1644). Women who were able to survive independently of their husbands coped better with widowhood than did those who relied on their husband for their livelihood. Compared to widows elsewhere in the world, who were often isolated and subject to assault and persecution, widows in places suitable for the production of cotton textiles maintained a decent standard of living and had relatively high social status. The new phenomenon of economically independent widows provided a strong signal of women's innate ability and helped to produce new cultural beliefs about women's worth.

By examining several outcomes after the end of premodern cotton textile production, I show that in addition to economically empowering women, premodern cotton textile production permanently changed cultural beliefs about women's worth. In early 20th century China, a higher share of industrial workers were female in places where there used to be cotton textile production; under state socialism, which outlawed most gender-biased practices, the probability of a wife's heading the household is higher in places where there used to be cotton textile production. In the absence of gender-biased economic and political institutions, the positive correlation between premodern cotton textiles and the probability of a wife's heading the household is most likely explained by the degree of the underlying gender bias.

A number of studies find that an increase in women's earnings leads to female empowerment (S. Anderson and Eswaran, 2009; Aizer, 2010; Ashraf, Karlan, and Yin, 2010; Deininger, Goyal, and Nagarajan, 2010). One closely related study is Qian (2008). Qian's (2008) study emphasizes a contemporaneous relationship between female earnings and sex ratios: she finds that in the period when relative female income increased, sex ratios became more balanced. She attributes the lessoning of sex ratio imbalances to household bargaining and women's preexisting preferences for daughters. In Qian's framework, increasing female incomes improves survival rates for girls contemporaneously. With the cotton revolution in imperial China, I explore whether a gender-specific income shock might have a permanent impact by transforming the culture. By having a sufficiently lengthy lag—as long as 160 years—between the initial income shock and outcomes reflecting underlying beliefs about the worth of women, I can disentangle the transitory effects of the income shock through an economic channel from its lasting effects through a cultural channel. I provide convincing evidence that cultural beliefs about women's worth were permanently transformed by the income shock in the past and those post-transformation beliefs can independently shape gender outcomes after the shock itself is long gone. In addition, I provide suggestive evidence that only when the value

of women's work reaches a sufficiently high level—relative to men's—can can shift gender norms, by showing that low-value work women performed in the past has no impact on sex ratio at birth today but high-value work does.

Previous studies have examined the historical origins of conservative gender norms. Alesina, Giuliano, and Nunn (2013) attribute conservative gender norms to the use of the plough which required upper body strength, whereas Hansen, P. S. Jensen, and Skovsgaard (2015) attribute conservative gender norms to the emergence of agriculture. This study explores the conditions under which conservative gender norms can be permanently changed. It shows that when the value of women's work exogenously increases to the level of men's, certain aspects of gender bias can fade into history even in a place like imperial China. In recent decades, certain aspects of gender norms and gender roles, such as the gender identity identity norm (Bertrand, Kamenica, and Pan, 2015), have been extremely resilient, despite increasing female labor force participation. This study suggests that with a larger shock, and particularly, a shock pertaining to the value of women's work, it is conceivable that the more resilient aspects of gender norms and gender roles can change as well.

A particularly attractive nature of the cotton revolution as a historical experiment is that it was a highly specific shock—it affected whether women could earn a substantial income without overhauling the rest of society. This setting reduces the number of intermediate outcomes arising from the shock. The cotton revolution increased the value of work performed by women, without inducing many changes in how they worked.[12] Cotton textile producers were small businesses composed of nuclear or extended families that used similar technologies throughout the period.[13] In a nutshell, the cotton revolution proceeded without bringing about change to the social structure or changing the relations of production.

Other important features of this historical case study are that (a.) Technologies associated with the cotton revolution are no longer used today. Traditional cotton textile production has been completely replaced by mechanized production. (b.) There was a unified state in both historical and modern China. (c.) The state also maintained a centralized army and, as far as possible, eliminated local monopolies of violence. This is a precondition to relative contributions to economic production being an important basis for gender inequality, according to the original hypothesis put forward by Marvin Harris. (d.) Industrialization did not take place in most places in China until recently.

[12] From 1300 to 1840, women continued to work from home. They did not move to the cities or enter into new social networks as a result of work. They also did not need to acquire an education in order to work. It was a single-dimensional shock to the value of women's work, as opposed to a multi-dimensional shock to their everyday life.

[13] The welfare effects of the cotton revolution over time were limited and largely eroded by population growth. Per capital incomes stagnated and slowly declined during this period.

Another strength of this setting is that China recently went through a phase of state socialism. Better identification can be attained in the historical "laboratory" of state socialism. In a usual setting, cultural beliefs about women's worth can directly shape gender outcomes by affecting private decisions, as well as indirectly shape outcomes by first shaping women's political and legal rights, educational and labor market outcomes. Given the high degree of centralization characteristic of state socialism, cultural beliefs about women's worth can only affect outcomes that can be determined solely by private decisions.

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 examines the change and the persistence of cultural beliefs about women's worth. 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 outcomes (Fortin, 2005; Fernández, 2007; Fernández and Fogli, 2009; Gneezy, Leonard, and List, 2009; Alesina, Giuliano, and Nunn, 2013; Bertrand, Kamenica, and Pan, 2015; Hansen, P. S. Jensen, and Skovsgaard, 2015; Jayachandran, 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. (Gneezy, Leonard, and List, 2009) find that women compete less, but only in patriarchal societies. Jayachandran (2015) surveys the roots of gender inequality in developing countries and finds that cultural norms help explain the male-skewed sex ratio in India and China. Scholars have also studied conditions under which gender norms might change. For instance, cable TV (R. Jensen and Oster, 2009), exposure to powerful women (Beaman et al., 2009) and state socialism (Görges and Beblo, 2015; Campa, Serafinelli, et al., 2016) are found to have helped to change gender norms and gender-role beliefs. This study shows that the cultural belief that women are worth less than men is an important determinant of women's status at home and sex selection, and that high-value work opportunities can potentially change such beliefs.

This study 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 Grosjean and Khattar (2015) who examine conservative gender norms and its origins in historical marriage market conditions in Australia.[14] This study sheds light on the change and persistence in cultural beliefs about women's worth. It 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 does contribute to the literature on sex ratio imbalances by identifying an cultural cause of observed sex ratio differences. Sex ratio imbalances, especially in India and China, have become an important topic of policy debate and have attracted widespread scholarly attention. Sex selection on a large scale is held to be responsible for a great share of the "missing women" evident in many parts of the world.[15] Although sex ratios at birth are particularly skewed in India and China, the phenomenon is by no means limited to those countries. Daul and Moretti (2008) and Almond and Edlund (2008) find evidence for sex selection even in the United States. Edlund (1999) explicitly models sex ratios in relation to son preference, indicating several factors that contribute to unbalanced sex ratios. Jayachandran (2015) confirms the crucial importance of cultural factors in sex ratio imbalances.[16] 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

This paper examines the cotton revolution in the historical context of late imperial China (1300-1840 AD). A one-time technology breakthrough in cotton textile production took place around 1300. Pre-existing political, economic and cultural institutions, which were uniformly present across China proper, required women, rather than men, to participate in the production of cotton textiles. Due to the presence of both a relatively well-functioning market and

[14] 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.

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

[16] Among non-cultural causes, 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.

historically specific government institutions, women in cotton textile regions had earning opportunities that far exceeded those available in past agrarian societies. With incomes derived from cotton textile production, women became major income earners within the household (B. Li, 1997).

The year 1840 is typically viewed as the watershed in Chinese history between the premodern and the modern era. It marked the end of the production of cotton textiles in a premodern context. After 1840, China opened up its market to the West after it was defeated in the first Opium War. Mechanized cotton textiles from the British Empire began to replace traditional cotton textiles produced by households in China.

Despite the rapid expansion of cotton textile production, the basic mode of production was preserved throughout this period. Economic, political and social structures remained intact. The level of output per capita stagnated due to the offsetting Malthusian forces of rapid population growth. The production of cotton textiles, like that of other goods, was highly decentralized, allowing individual spinners and weavers to reap most of the gains from their production but limiting further technological innovation (Elvin, 1972). Appendix F details the market structure and features of decentralized production during that period.

A Initial Conditions

A.1 State taxation and Women's Textile Production

In imperial China, in-kind state taxation ensured that both men and women engaged in work. Under the state tax system that dated back to 300 AD, each household was required to pay in-kind taxes in both grain and textiles (Bray, 1997). Because women were far more productive in textile production than in plough-based grain production, for which male labor was essential, they specialized in producing textiles. By the time of 1300 AD, when the cotton revolution took place, spinning and weaving had long been deemed as womanly skills.

A.2 Confucianism and Conservative Gender Norms

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.

B The Cotton Revolution

In early times, silk and hemp were the two main fabrics used for clothing. High-quality silk was the most valued of all fabrics. It was produced in a few urban shops, used in more expensive clothes and as part of international trade. Hemp was the predominant fiber for ordinary clothes. After 1300, cotton gradually replaced hemp, low-to-medium grade silk or a mixture of both (*sibu*) to become the dominant fiber.

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 her mainland China.[17] 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. As new spinning and weaving technologies for processing the cotton were put to use, the production of cotton textiles became economically efficient for the first time in history (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 rather than just using their hands. It has a design similar 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, the pervasiveness of which had resulted in a bottleneck that prevented the the cotton textile industry from increasing productivity–before the new spinning wheel was put to use, every weaver had to be matched with three to four spinners given the rate at which spinning took place. Other than the new spinning wheel, she 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 being durable, adequate for cold-weather, and offering higher yields per unit of land, cotton largely replaced hemp and began to dominate the everyday clothes market.

C Traditional Division of Labor and Labor Market Efficiency

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. And there is no evidence that women's

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

specialization in textile production changed much after cotton revolution. Like other premodern states, imperial China did not collect statistics on the composition of the labor force. But it is clear 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).

Other than the long-standing institution of in-kind taxation, there are several reasons that might explain why the division of labor did not change significantly over this period. First, the cotton revolution was a one-time technological breakthrough and never led to mechanization. Compared to mechanized or industrial textile production, handicraft cotton textile production did not have the same increasing returns to scale. Since textile work did not take place in factories, there was minimal conflict between demands from work and family. In some sense, the level of technology during that period complemented and preserved women's existing way of life, which further solidified traditional division of labor. Second, many families owned small plots of land; indeed the majority of the population were small land owners throughout much of imperial Chinese history. Due to the upper-body strength required by using the plough, men performed most of the tasks in the field. High rates of small land holding were, therefore, associated with men working in the field, which prevented them from being full-time textile workers.

From a modern perspective, it might appear as puzzling why wages difference differentials between men and women were across regions were not eliminated over time. The key explanation to this is that the labor market was far from having free mobility, which is more than usual for a premodern society. But in China, there was also a deliberate attempt from the imperial government to restrict labor mobility. During much of the Ming Dynasty (1366-1644), occupational status was still by inheritance and individuals were supposed to stay where they were officially registered. On top of that, individuals were tied to their extended families due to the clan system. All of these severely constrained the reallocation of labor to places with higher wages. The characteristics of the pre-industrial production in China can be further illustrated by comparing it to the British putting-out system (Appendix F).

D Women as Primary Income Earners

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. Robert C. 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.

Women who had the skills to weave artisan cloth could earn an even higher income. The production of artisan cloth was backed up by popular demand of weddings and funerals in premodern China. Weavers had to have greater skills and to work longer hours in order to produce 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 and to sell them to non-local markets. This allowed 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. And this revolution affected both married and unmarried women.

E Transitions in Gender Norms

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.[18] In many societies, there exists an important 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. Whereas in practice, men and women have the option of staying out of the marriage market, which leaves those norms intact.[19] However, in premodern China, because of a tradition of universal marriage, men and women did not have the modern option of staying out of the marriage market. And in the case of the cotton revolution, as women began to earn more ubiquitously in places with cotton textile production, it is indeed conceivable that this gender identity norm had to break down, and men and women had to accept the new economic reality that the wife now earns more than the husband.

Due to women's highly productive manual labor in cotton textile production, women began to be seen as more important members of society. Pomeranz (2005) uses the term "economics of respectability" to describe women's rising status. For parents, as women be-

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

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

came productive members of the economy in their own right, it became less financially costly and mentally stressful to have a daughter. The prospect of daughters being self sufficient lowered the cost of having them. Economic independence can also have a positive impact on women's self perception.[20] And anecdotal evidence suggests that women producing cotton textiles enjoyed greater autonomy and higher social status (C. Zhao, 2015).

A similar process took place in elsewhere in the world in other periods in history. The main difference is that these other historical episodes were not as long lasting and wage differentials in those cases tended to equalize rapidly. 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 she began to work on well-paying jobs in textile mills (Dublin, 1993).[21] 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.[22]

IV Data

I combine several gazetteer-based sources to construct my main variable, premodern cotton textile production. 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 done by Christian missionaries in the early twentieth century. For modern outcomes and controls, I use modern censuses and surveys, including the county-level National Population Census in 2000, individual-level censuses (1982, 1990) from 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 download 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, variable constructions.

[20] 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 just passionate about literary writing and painting, and was completely clueless about how to make both ends meet.

[21] 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."

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

A Explanatory Variable: Premodern Cotton Textiles

To obtain an estimate of the distribution of counties and prefectures that previously produced cotton textiles (1300-1840 AD) across China today, I map historical locations of cotton textile production into modern counties.[23]

Historical gazetteers provide qualitative information on cotton textile production. Information on premodern cotton textiles can often be found in a section dedicated to locally-produced goods (*shihuo zhi*). I code premodern cotton textile production as one, when *mian bu* or *jibei bu* is recorded for a specific county or prefecture. *jibei* is just an alternative name to *mian*. They both refer to cotton. *bu* means cloth, which distinguishes cotton cloth from raw cotton. 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.

I rely on two types of sources: county-level and prefecture-level sources (Figure A.V). For prefectures, their historical boundaries are known; but for counties, not until 1911. In 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 its "ancestor" county had cotton textile production between 1300 and 1840; zero is assigned otherwise.[24] 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 premodern cotton textiles 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 source materials. For example, when a record is from a prefecture-level gazetteer published in 1503, it is geocoded as in that particular prefecture with its boundaries in 1503.

Other than the default method, I also code premodern 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 premodern 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. And reassuringly, this also yields highly comparable estimates

[23]The year 1840 marks the end of cotton textile production in a premodern setting. Section III provide detailed background information for the cotton revolution and premodern cotton textile production.

[24]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 reflect the local presence of cotton textile production even if the production began slightly before 1368.

to estimates obtained with the default 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 premodern cotton textile production 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 premodern cotton textile production. However, two types of biases are present in gazetteer data: publication bias and survivorship bias (Appendix B.2). My solutions to this are as follows: first, I use a binary treatment variable that can best avoid introducing spurious correlations between premodern cotton textile production, level of development and cultural beliefs about women's worth; second, in Table A.IX, I run several regressions based on the number of gazetteers a county is associated with. And I find that my coefficient estimates are not sensitive to gazetteer frequency, which suggests that "publication bias" and "survivorship bias" do not drive my results.

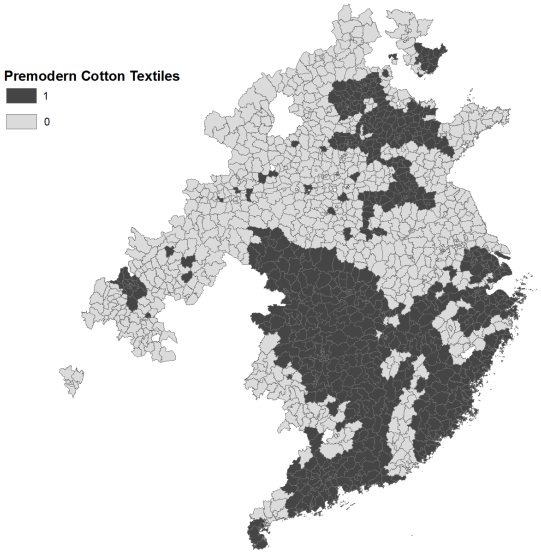

Figure I: Premodern Cotton Textile Production (1368-1840)

B *Main Outcome Variable: Sex Ratio at Birth as a Proxy for Cultural Beliefs about Women's Worth*

My main outcome variable is the sex ratio at birth from the 2000 Census. Data on sex ratio at birth are available at the county level. There is considerable variation in sex ratios

at birth. The range is from 81:100 to 193:100.[25]

Biases against women can lead to female infanticide, child neglect and underinvestment in girls. Due to the prevalence of sex-selection technology, the manifestation of biases against women has shifted towards an earlier stage of reproductive process: pre-natal sex selection. Deliberate sex selection at a lower-parity birth distorts sex ratios (Ebenstein, 2010). I argue that conditional on other factors (such as law, religion, technology and fertility), sex ratio at birth reflects the underlying gender bias.

Controlling for contemporaneous economic forces, sex ratio at birth in the 2000 Census should accurately reveal the cultural beliefs about women's worth. This variable has the following strengths as a proxy for underlying cultural beliefs about women's worth: (a.) Sex selection technologies became widely available in the 1990s. Although China started to import ultrasound scanners as early as 1980s, they only became cheap and widely available after 1990. By the mid-1990s, the majority of county-level hospitals, township-level clinics and local family planning agencies were equipped with ultrasound scanners (Anukriti, Bhalotra, and Tam, 2015). (b.) Around 2000, regional variation in the content and enforcement of the one-child policy was largely limited to two categories: urban versus rural *hukou* (household registration), which I control for in all regressions. 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 helps to reduce the bias from women from progressive regions opting out of marriage and motherhood. (d.) Data quality of the 2000 census is higher than subsequent censuses. After 2000, a floating population composed of 200-million temporary migrants affected the accuracy of the population censuses.[26]

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 (Jayachandran, forthcoming) in Appendix C.2 and show that access to ultrasound screening varied over time and became widespread by the late 1990s (Appendix C.3).

C Control Variables

In this section, I outline the 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

[25] After the exclusion of five autonomous regions, there remains a wide range of sex ratios (92:100 to 193:100) across counties.

[26] 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 usual to double count an individual in the place (by current residence) he worked and in his hometown (by household registration).

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), men's years of schooling, 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.

In comparing high-value work with low-value work, I include *cotton suitability*, *tea suitability* and *rice suitability* from FAO, production data on other types of textiles from gazetteers. Suitability maps are available in Appendix A. To assess the impact of large political and economic 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 raised 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 Premodern Cotton Textiles and Sex Ratio at Birth: A County-Level Analysis

A Baseline Results

Having constructed a county-level measure of premodern cotton textile production, I can examine the relationship between premodern cotton textiles and modern outcomes.[27] I begin by examining variation at the county level. I test my hypothesis by estimating the following equation:

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

where c denotes a county. Premodern cotton textiles$_c$ is premodern cotton textile production 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 premodern cotton textiles and may still affect present-day outcomes. I include in $\mathbf{X}_c^H$ agricultural suitability and estimated population density in 1300. 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 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). Due to a lack of historical population data at the county level, I use estimated population density in 1300 from Goldewijk, Beusen, and Janssen (2010) and Klein Goldewijk et al. (2011). The distribution of premodern cotton textiles depended on the trade networks. I 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 as well. 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.[28] To address norms such as patrilocality and concern for women's purity (Jayachandran, 2015) and other differences across those historically relatively autonomous regions, I include fixed effects corresponding

[27] 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 with this alternative measure.

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

Table I: Premodern Cotton Textiles and Sex Ratio Imbalances: OLS Results

	Dependent variable: sex ratio at birth					
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of Dep. Var.	118.3	118.3	118.6	118.6	118.6	118.6
Premodern cotton textiles	-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 (men)			-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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

to socioeconomic macroregions defined by Skinner, M. Henderson, and Berman (2013).[29]

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) and men's years of schooling, and political characteristics including governance status and provincial capital status.[30] I include the share of the ethnic population in $\mathbf{X}_c^C$.

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

[30]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

Men's years of schooling is used to proxy for modernization.[31] Sectoral composition is included as a control as sex selection can be a function of economic opportunities available to adult males and females (Rosenzweig and Schultz, 1982). Share of urban *hukou* is used to proxy for urbanization, as well as to capture an important source of variation in the one-child policy.[32] Governance status of the county and provincial capital status are intended to capture another important source of variation in the one-child policy through political control. Both share of urban *hukou* and governance status could have an effect on sex ratio at birth through the one-child policy (Ebenstein, 2010). In addition, the share of ethnic minority population is included to reduce composition bias as there is a clear cultural component in son preference peculiar to the Han Chinese.[33]

The OLS estimates show that in counties with premodern cotton textile production, fewer girls are missing today. The coefficient estimates are both statistically significant and economically meaningful. I start 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. Premodern cotton textile production 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 at birth.[34] Column 3 serves as a baseline regression 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 for premodern cotton textiles is not influenced by a small number of counties.

In column 4, the coefficient estimate remains similar when I control for logged per capita GDP, logged share of urban *hukou*, logged share of agricultural workforce and logged share of service workforce and men's years of schooling.[35] In column 5, in addition to controls omitted

government, two when it is self-governed, and three when it is governed by the province-level government.

[31] Average years of schooling is a more common proxy for modernization, but in this context, men's years of schooling is used in lieu of years of schooling, as female education is most likely endogenous to differential parental investments.

[32] Although the one-child policy was strictly enforced among Chinese citizens with urban hukou, a more lenient version was enforced among those with rural *hukou*.

[33] Autonomous counties and prefectures, which are predominately resided and governed by ethnic minorities, are already excluded from the main sample.

[34] 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. Jayachandran (forthcoming) attributes worsening sex ratios with economic development to the desire for small families. Fertility is less of a concern for this study, because a strict birth quota was imposed by the one-child policy.

[35] 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.

from column 4, I also exclude men's years of schooling and share of ethnic population.[36] In the last column, I exclude political variables including provincial capital status and governance status. Both are important determinants of the enforcement of the one-child policy. After omitting political controls, the coefficient estimate remains close to those in previous columns.

One might still suspect that counties with and without cotton textiles in the past are systematically different 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 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.) using alternative outcome variables from the 2000 census such as sex ratios among older cohorts and education attainment; (vi) accounting for historical and modern confounders (pre-1300 commercial networks, historical state presence and modern industrial composition); (vii.) checking three main hypotheses in previous work: ancestral plough use (Alesina, Giuliano, and Nunn, 2013), Neolithic settlements (Hansen, P. S. Jensen, and Skovsgaard, 2015) and soil texture (Carranza, 2014);(viii) examining variation within populations speaking the same language only. Appendix E summarize the results of the above tests.

B High-Value vs. Low-Value Work

Cotton textile production was high-value work for women. This cotton revolution increased the quantity that could be produced per unit of time. Although cotton textiles did not have the highest unit value, being able to produce them at a large quantity could still generate a handsome income for women. Moreover, while the new spinning and weaving technologies were promoted to the rest of China, they were only able to set roots in places where geo-climatic conditions favored the production. And due to a lack of equalization in wages due to labor market inefficiency (Section III.C), women in places suitable for cotton textiles earned a sustained "wage" premium over long periods of time. This is what made

Zhang, 2011). In either case, controlling for log per capita GDP will constitute the case of "overcontrolling" [pp.64-68](Angrist and Pischke, 2008).

[36]The share of ethnic population might have become more endogenous to the dependent variable in the past few decades due to the differential application of the one-child policy on Han Chinese and ethnic minorities. Huang and Zhou (2016) has documented that inter-ethnic marriages have become more common under one-child policy, as ethnic minorities are often not subject to birth quota.

cotton textile production a very different economic activity from other economic activities performed by women at the time.

B.1 Cotton Cultivation

Apart from spinning and weaving, the cultivation of cotton often involved women too. Through spinning and weaving, raw cotton is turned into into cotton fabrics. By and large, the locations of cotton cultivation did not overlap with the locations of spinning or weaving, due to different climatic constraints (See Appendix A for a map of cotton suitability).[37] Using cotton suitability to proxy for cotton cultivation, I find a negative but insignificant coefficient of cotton cultivation (column 1). In column 2, I include both cotton textile production and cotton cultivation. The coefficient estimate of cotton textile production does not change much from the baseline estimate. In column 6, I use a dummy variable of raw cotton, and find a negative but insignificant coefficient still. This suggests that cotton cultivation does not alter cultural beliefs about women's worth as effectively as higher-value work, i.e. cotton spinning and weaving.

B.2 Tea Production

In China, women had a long-standing historical role in tea picking (Lu, 2004). 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. Tea production is the most prevalent in southern provinces (See Appendix A for a map of tea suitability). To account for tea production, 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 on cotton textile production 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 stable a cash flow. This is consistent with the hypothesis that the value of women's work was crucial to changing cultural beliefs about women's worth. Participation in the labor force alone was not sufficient to generating the same effects.

B.3 Rice Cultivation

Women's participation in rice cultivation is more extensive than in wheat cultivation. However, women's role in rice cultivation was never as major as their role in textile production. Just like wheat agriculture, rice agriculture was plough based and required the upper body strength of men. Overall, I find no significant effects of rice suitability on sex ratio at birth (column 7). In column 8, I include both cotton textile production and rice suitability, which

[37]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.

Table II: High-Value and Low-Value Work

	Dependent variable: sex ratio at birth										
	(1) Continuous	(2) Continuous	(3) Dummy	(4) Continuous	(5) Continuous	(6) Dummy	(7) Continuous	(8) Continuous	(9) Dummy	(10) Dummy	(11) 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
Premodern cotton textiles		-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 low-value work alone. Other columns regress sex ratio at birth on both cotton textile production and other types of 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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 but 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]

B.4 All Textiles

Women engaged in the production of more than one type of textiles, but silk and hemp typically yielded a lower income for women. To separate the effects of high-value work from the effects of low-value work, I include a control for the production of all textiles.[39] I find that the production of textiles in general has no significant impact on sex ratio at birth (column 2), once after controlling for cotton textiles. This is not too surprising given that hemp had a much lower unit value, and was produced in smaller quantities, whereas the type of silk that could be produced at home by women tended to be low-ended and was similarly produced in small quantities.[40] Table A.XVI suggests that cotton textiles accounted for 24.39% of the total value of domestic trade, in comparison with raw cotton, 3.3%, raw silk, 3.1% and silk textiles, 3.75%. This is also consistent with the historical fact that cotton became the dominant fiber after 1300; cotton textiles largely replaced hemp textiles in the day-to-day clothes market.

C Post-1840 Political and Economic Shocks

C.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 with premodern cotton textiles overlapped with areas that experienced early industrialization, my results would confound the effects of industrialization with the effects of premodern cotton textile production. 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.

[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 as well. 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.

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

[40]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.

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 premodern cotton textile production and the effects of female labor force participation after 1840.[41] Knowing 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 regression. Columns 1-3 of Table III show coefficients of interest after controlling for or omitting treaty ports. Being a treaty port in the past indeed has an impact on sex ratio at birth. The interaction term between treaty port status and premodern cotton textiles is close to zero and insignificant, suggesting that premodern cotton textile production has no differential impact on modern sex ratio imbalances by treaty port status. I also drop all treaty ports in column 3 and this slightly increases the coefficient size of premodern cotton textiles.

C.2 Expansion of Christianity

Christianity has a particular emphasis on human life. Expansion of Christianity after 1840 might have constituted a source of variation in willingness to conduct sex selection. In the 19th and early 20th century, missionaries came to China to spread Christianity. Christianity might have shaped attitudes towards infanticide and gender-role attitudes. Despite the small share of Chinese populations that were ever converted, some of them might have 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 the regression in column 4. As expected, a greater share of communicants in the population reduces sex ratio at birth. The size of the coefficient of interest increases by one-fifth, suggesting that some of the effects of premodern cotton textiles might have been masked by the effects of missionary activities. Counties with no history of cotton textiles seemingly had a higher density of communicants. I interact the density of communicants with premodern cotton textiles in column 5. The coefficient is positive for the interaction term, but not statistically significant. This implies the effect of premodern cotton textile production is smaller for counties with a greater share of communicants, and likewise, the effect of Christianity is smaller for counties with premodern cotton textile production. In column 6, I drop all counties with more than 10 communicants per 10,000 residents; the estimated coefficient slightly increases in size.

[41] Section VI.C provides evidence that women in provinces with more premodern cotton textile production 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.

Table III: Post-1840 Political and Economic Shocks

	Dependent variable: sex ratio at birth										
	(1)	(2) Early Industrialization	(3)	(4)	(5) Christianity	(6)	(7)	(8) Economic Liberalization	(9)	(10) All	(11) 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
Premodern cotton textiles	-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)
Premodern cotton textiles× Treaty port		-0.138								-0.817	
		(1.929)								(2.858)	
Christianity				-0.348	-0.852*					-0.802*	
				(0.382)	(0.487)					(0.480)	
Premodern cotton textiles × *Christianity*					1.121*					0.858	
					(0.666)					(0.675)	
Coastal							-2.288	-4.843***		-6.164**	
							(1.515)	(1.822)		(2.539)	
Premodern cotton textiles × 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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C.3 Post-1979 Economic Liberalization

Between 1949 and 1979, the strict socialist regime minimized the effects of cultural beliefs about women's worth by blocking most of the channels through which beliefs can affect outcomes for women. After 1979, the Chinese Government gradually liberalized the market and relaxed its control on society. Previously hidden gender inequality could become uninhibited (J. Li and Lavely, 2003). There still remains very little variation in either labor laws or maternity leave law at a regional level, but relaxed political control and rapid economic growth could have allowed some regions to develop informal rules that are highly relevant for the prospects of women in the workplace. Below I address the effects of economic liberalization on sex selection.

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. One concern is that coastal regions are the same regions that had cotton textile production in the past.[42] I already have per capita income in the baseline regression to control for the direct impact of economic development; to account for other effects of economic liberalization, I include the coastal region as a dummy (column 7), interact the coastal region with premodern cotton textiles (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.

Lastly, I include controls for all three large political and economic shocks and interacted them with premodern cotton textiles in column 10. This results in a sample of 993 counties. I find that if those shocks can be taken as exogenous, premodern cotton textile production reduces sex ratio imbalances by 6.2 boys per 100 girls in places with no exposure to any of the shocks. Using the same sample but without controlling for those shocks, premodern cotton textile production reduces sex ratio imbalances by 4.2 boys per 100 girls (column 11).

D Instrumental Variable Strategy

In spite of performing a number of robustness tests and accounting for large political and economic shocks, I still 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 that the counties

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

in which cotton textiles were produced may have a higher likelihood of adopting new textile technologies because of economic or political conditions. It is possible that counties that were economically more developed were more likely to have adopted new technologies, and counties closer to the market or transportation routes were more likely to sustain its production and make greater profits. If these counties were more gender equal to begin with, or more likely have accomplished gender equality later for other reasons, this would bias the OLS estimates away from zero. Though 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 regression, I am unable to address likely issues caused by unobservable characteristics, such as attitudes towards women prior to cotton textile production at a county level. In addition, due to the nature of gazetteer data, my estimates can suffer attenuation bias due to measurement error in the explanatory variable.

D.1 Logic of the Instrument

A few factors are known to be crucial for producing cotton textiles, such as a wet climate. One of those factors 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 testing 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 products are of much poorer quality compared with those produced in favorable climates. Low humidity has a particularly negative impact on high-ended cotton cloth, as high-quality cotton cloth can only be produced when relative humidity is close to or greater than 70%.

Variance in relative humidity affects production decisions. Many parts of China are dry in the winter. The dry weather can certainly lower cotton textile output for those months. To capture seasonal variance in suitability, I use monthly information on relative humidity to compute the humid-for-weaving index. Because a spinning wheel or a weaving loom entails a fixed cost, the total amount of time during which cotton textile production is viable would

be a key consideration for the ownership of a spinning wheel or a weaving loom. A similar logic applies to within-24-hour variance in relatively humidity. Because the bulk of the work was performed during the day, historically, I focus on humidity in the daytime (rather than at night) when most of the spinning and weaving occurred.

The benefit of having a relative humidity index specific to weaving, and especially, to weaving in the daytime, is that I can extract useful information from relative humidity without introducing biases due to correlations between weaving suitability and suitability for other economic activities. Also, because the output of cotton textile production increases in the relative humidity index, it provides more information than the treatment variable I use in OLS regressions, which is categorical.

D.2 Construction of the Instrument

I first construct a relative humidity index pertaining to suitability for weaving. The index is termed the "humidity-for-weaving" index. The first set of data is the 30-year monthly average relative humidity 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. In addition, I use relative humidity data 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. The second set of data is at a higher frequency but a lower resolution (2.5 degree by 2.5 degree). I only use it to refine the monthly measure built from the first set of data.

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 (full-day) relative humidity; step three, I obtain the distance between daytime humidity and optimal humidity. Based on Stamper and Koral (1979) and Iqbal et al. (2012), weaving can be performed when relative humidity is between 60% and 85%.[43] I take the distance between daytime humidity and 85%. The maximum distance is 25%. The distance to optimal humidity decreases in suitability; step four, I aggregate obtained monthly values over twelve months; step five, I take the inverse of the total to create a humidity-for-weaving index such that the index increases in suitability for weaving, and multiple it by 1,000. The index values range from 3.379 to 15.124. Figure II shows the distribution of humidity-for-weaving index at a county level in eight quantiles. Darker shades represent higher relative humidity and hence, higher weaving suitability. Miss-

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

ing values are shaded white. The finer details of the construction procedure are available in Appendix D.1.

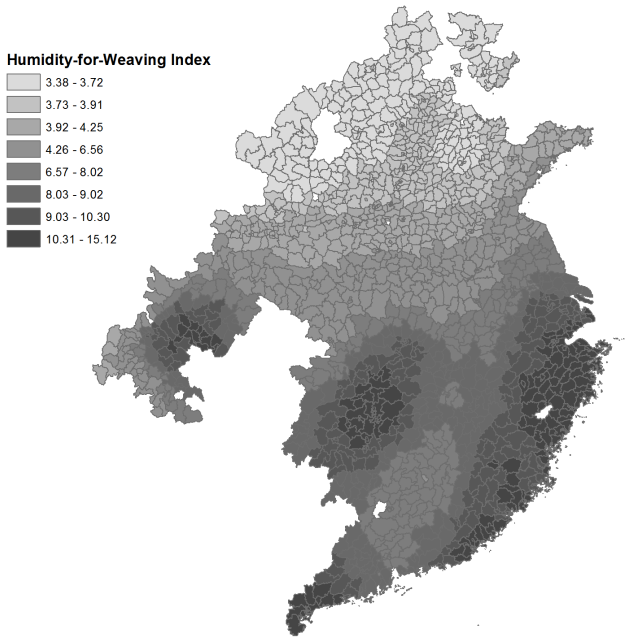

Figure II: Humidity-for-Weaving Index

D.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 premodern cotton textile production. One concern is that relative humidity may have affected the productivity of producing other types of textiles or growing cotton. Another concern is that relative humidity may have had an additional impact on sex ratio at birth through the formation of other ancestral traits of the modern population. Although the humidity-for-weaving index is built around the ideal conditions for weaving, the ideal conditions for weaving may well be ideal for other economic activities.

To address such concerns, I regress the relative humidity index on all types of textiles, cotton suitability and overall agricultural suitability, respectively. I show in Table IV that the instrument is strongly correlated with the manufacture of cotton textiles, but not correlated with the cultivation of raw cotton (proxied for by cotton suitability), all types of textiles (after controlling for cotton textile production) or overall agricultural suitability. This is not surprising due to the scientific fact that other types of textiles are best produced at a very different level of relative humidity. Silk is, for example, best weaved at a relative humidity

Table IV: The Impact of Humidity-for-Weaving on Other Outcomes

	(1) Premodern cotton textiles	(2) Silk or hemp	(3) Raw cotton	(4) Agricultural suitability
Mean of Dep. Var.	0.478	0.784	0.555	4.807
Humidity-for-weaving	0.0408***	-0.00204	-0.0185**	-0.0647*
	(0.0109)	(0.00874)	(0.00857)	(0.0344)
Baseline controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.441	0.445	0.715	0.615
Observations	1483	1483	1478	1483

Notes: The table reports falsification tests of 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 happens to be 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 60 to 70% (Stamper and Koral, 1979). The same source lists suggested ranges 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.

To create a more exogenous source of variation in premodern cotton textile production, I use the interaction of the humidity-for-weaving index and distance to the center of national market (Suzhou) as my second instrument. The construction of the second instrument draws insights from Pearl (2000). Without access to national market, the production of cotton textiles would most likely be limited to home use. The distance to the center of national market itself is not an instrument, though, since distance to the center of national market likely affects modern gender outcomes through past development. However, this does not invalidate the second instrument. According to Pearl (2000), the interaction terms between non-instrumental variables can still be an effective instrument.

D.4 Instrumental Variable Results

I begin my IV estimation by testing the relationship between my instruments and premodern cotton textile production. 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

[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: Premodern Textiles and Sex Ratio at Birth: Instrumental Variable Analysis

	(1) OLS	(2) IV	(3) OLS	(4) IV
	Humidity-for-weaving		1/Humidity-for-weaving × log(dist. to Suzhou)	
	Panel A: 2SLS Dependent variable: sex ratio at birth			
Mean of Dep. Var.	118.7	118.7	118.7	118.7
Premodern cotton textiles	-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: premodern cotton textiles			
Humidity-for-weaving		0.255***		
		(0.553)		
1/Humidity-for-weaving				-3.3680***
× log(dist. to Suzhou)				(0.605)
Pseudo R^2		0.417		0.428
Humidity-for-weaving	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 IV estimates. 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 areincluded in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

index and premodern cotton textile production in order to best mitigate the problem of weak instruments due to 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 premodern cotton textile production. Third-stage results are reported in Panel B. The second stage is to calculate the predicted probability of premodern cotton textile production. Column 1 contains 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 premodern cotton textiles leads to a reduction of sex ratio at

[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 strength of the instrument is very high. He shows that 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.

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 Change and Persistence in Cultural Beliefs About Women's Worth

A Modern Evidence on Cultural Beliefs about Women's Worth

Having shown the relationship between premodern cotton textile production and objective measures of cultural beliefs about women's worth, I turn to subjective measures of those beliefs. CGSS 2010 (Chinese General Social Surveys) has several subjective measures of gender bias, providing additional evidence to test the link between cotton textiles and gender bias. Ideally, I would like to see the effects of premodern cotton textile production on more outcomes that would reveal gender bias, and in multiple historical episodes. But unfortunately, such data rarely exist even for contemporary China.

The survey contains questions regarding cultural beliefs about women's ability and worth. 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). The first measure of cultural beliefs about women's worth 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.

Table VI: Gender Bias in Contemporary China:
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.	3.006	3.006	3.006	3.659	3.659	3.658	0.0975	0.0974	0.0975
Premodern cotton textiles	-0.244***	-0.243***	-0.239***	-0.195***	-0.191***	-0.183***	0.182^{+}	0.180^{+}	0.200*
Age group	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Female	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Education	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Female ×Education	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Individual controls	No	No	Yes	No	No	Yes	No	No	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2/Pseudo R^2	0.0287	0.0952	0.102	0.0535	0.119	0.127	0.014	0.025	0.030
Observations	6161	6156	6146	6168	6162	6152	6105	6100	6084

Notes: The table reports the impact of premodern cotton textiles on gender-role attitudes and daughter preference. The unit of observation is a survey respondent in CGSS 2010 (Chinese General Social Surveys). Baseline controls are the same as in column 3 of Table I. Robust standard errors are included in all specifications. Standard errors in parentheses $^{+}p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

I regress premodern cotton textile production on answers to those questions with the same controls in column 3 of Table I. Table VI summarizes the results. Columns 1-6 report OLS results for beliefs about women. Columns 7-9 focus on daughter preference. The first columns under each question (columns 1, 4 & 7) contain no individual controls; the second columns (columns 2, 5 & 8) include basic individual controls such as age group, gender and education attainment; and the third columns (columns 3, 5 & 9) contain a full set of individual controls. I find that individuals in counties with premodern cotton textile production are more likely to disagree with the statement that men are naturally more capable, or that women should focus on family, and are more likely to have daughter preference. Results suggest that premodern cotton textile production is associated with less biased beliefs about women's worth.

B Change in Cultural Beliefs about Women: The case of widow survival, 1368-1644

The cotton revolution began around 1300. By the end of the Ming Dynasty (1368-1644), vast historical evidence indicates that a change had taken place in gender norms. To shed light on the timing of this transition and the formative years of new gender norms, 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 survive but also to support their children and in-laws (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 woman", however, provide information on widow suicide. The "virtuous woman" 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). For more details on Song-Ming Neo-Confucianism and "virtuous woman", please refer to Appendix F.4.

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 woman" 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

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
Premodern 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 premodern cotton textiles 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.[46]

Table VII summarizes the results. Column 1 shows an unconditional relationship between premodern 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 premodern 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 premodern cotton textile production consistently predicts a lower number of "heroic widows".

The above exercise provides some suggestive evidence that premodern cotton textile

[46] 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.

production reduced widow suicide. Ideally, I would like to compare widow suicide rates before and after the cotton revolution (1300-1840). In practice, not many 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 this exercise to be carried out.

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.[47] Improvement in the well-being of widows contributed to women coming to occupy a more substantial space in society (Bray, 1997; Pomeranz, 2004; C. Zhao, 2015).

C The Effects of Premodern Cotton Textile Production After 1840

To provide further evidence that premodern cotton textile production transformed the culture, I examine the effects of premodern cotton textile production after 1840. Data are quite scare for this period. As a first approximation, I examine the share of female workers in the industrial workforce in the early 20th century, and present descriptive evidence for the enduring impact of premodern cotton textile production.

The composition of the workforce is simply unknown prior to the Republican Era (1911-1949). The 1916 Economic Census is one of the earliest modern censuses. It 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. On average, roughly 19% of the workers were female by province-industry pair. Women made up a sizable portion of the industrial workforce in Jiangsu, Zhejiang and Shanghai, where women even outnumbered men, whereas 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, which cannot be explained by a prior history of women working outside of home, since the vast majority of women in China, no matter where they were from, did not work outside of home prior to this period. It was more likely driven by whether or

[47] 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.

not the gender identity norm was still held that the husband should earn more than the wife. Alternatively, there could be 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 higher-wage jobs at the time.

This is by no means the best measure of cultural beliefs about women's worth. However, for that period, no information is available for most of the outcome variables examined in the modern literature, such as sex ratio at birth, female education attainment, or indicators of spousal relations. Also, disaggregated data would be more suitable for the purpose of studying female labor force participation decisions, but unfortunately, the Chinese state did not yet have the capacity to collect labor statistics at an individual level. For the above reasons, the following results should be seen as simple correlations and suggestive evidence.

I regress premodern cotton textiles on the share of female workers in the industrial workforce. Table VIII suggests that in provinces with a higher share of population exposed to home-based premodern cotton textile production, 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. Premodern cotton textile production is 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 cultural beliefs about women's worth, and that the change remained in place after the end of premodern cotton textile production.

D Under the Microscope of State Socialism: 1949-1990

Next I examine the effects of premodern cotton textile production in the setting of state socialism. One main shortcoming of relying on the share of female workers to investigate the effects of premodern cotton textile production is that many political, economic and social factors are at play in the decision of labor force participation. Exploiting the setting of state socialism, where many political, economic and social forces were heavily regulated by the state, I am much more able to isolate the effects of premodern cotton textile production from other determinants of gender outcomes. In addition, due to state centralization, cultural beliefs could not easily influence local economic, political and legal institutions at a local level. This allows me to separate the direct effects of cultural beliefs from their indirect effects through institutions.

From 1949 to the early 1990s, the state tightly controlled and centralized most political,

Table VIII: Premodern Cottion Textiles, Gender Norms and 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
Premodern cotton textiles	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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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 featuring the greatest level of political control, Individuals were allowed to choose their head of the household. Families members had to decide whether the husband or the wife should become the head of the household. Using the 1990 Population Census, I turn to a micro-level analysis that examines variation in the gender 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".[48] 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%

[48]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

of the heads of the households were wives. During this period, men and women had equal formal rights. The head of the household status did not carry any substantial benefits or entitle one to additional legal rights. Symbolically, the head of the household status does still have the cultural connotation of leading and running a family. For most, the idea of having a wife as the head of the household simply does not come across their mind, because it directly contradicts the norm of having a male to be in a dominant position within a group. I thus use "wife heading the household" as a proxy for gender bias.

Table A.II describes the main sample based on the 1990 Census. The sample is restricted to those who are the heads of the households, Han Chinese and married. The sample has the same geographic coverage as does the main sample in Section V.[49] Approximately 47% of the total population lived in a prefecture exposed to premodern cotton textile production. By the time of the census, migration was still rare; many individuals lived in the same town as their ancestors.[50]

My estimation equation is

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

where p denotes a prefecture.[51] My outcome variable is "head of the household". Premodern cotton textiles$_p$ is premodern cotton textile production in Prefecture p.[52] If premodern cotton textiles were 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

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

[50] Compared with later censuses, a small floating population means double counting was relatively rare.

[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 premodern cotton textile production are coded as one; prefectures with less than 10% of the territory with premodern 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 premodern cotton textile production, a binary variable is used in all regressions. The continuous variable, however, yields similar results.

Table IX: Premodern Cotton Textiles and 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
Premodern cotton textiles	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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

as educational attainment, occupation and migration status, which are likely endogenous to cultural beliefs about women's worth. In column 4, I include the natural log of population density in 1820. My coefficient estimates are highly stable across the columns. In a county with premodern cotton textile production, 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 premodern cotton textile production affects present-day outcomes. This lends more confidence to the main hypothesis that premodern cotton textile production transformed cultural beliefs about women's worth.

The above analysis shows the impact of premodern cotton textiles remains under state socialism. The coefficient estimates of premodern cotton textiles should be interpreted as the direct effects of rather than the total effects of cultural beliefs about women's worth. In other words, if cultural beliefs about women's worth were able to freely shape local political and legal institutions through aggregated preferences, the magnitude of the estimates would be greater. In addition, state socialism likely shaped cultural beliefs about women as well. To

demonstrate the impact of state socialism on cultural beliefs about women, 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 transform cultural beliefs about women's worth. However, several conditions were necessary for such a change to occur. One important 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). Another favorable 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 family. 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.

There is no denying that several historical contingencies enabled women to reap the benefits of the cotton revolution and to earn such a high income. Imperial China had a "quasi-socialist" state. The traditional division of labor in which men did field work and women did textile work, was partly induced by state in-kind taxation. Cultural traditions governing land ownership also contributed to men's stagnant productivity 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 at zero opportunity cost. Women's involvement in textile work, often as early as in their pre-teen and teen years, did not crowd out their educational attainment.[55] Although historical contingencies were critical in enabling women to earn high incomes for such a long period, the fact remains that when women have the opportunity to earn high incomes, a shift in cultural beliefs could occur. Also, for women to earn high incomes in today's world, one does not need identical conditions to those in Imperial China.

[55]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).

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.

There are a few other caveats regarding 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, itself is a product of autocratic rule, means that individuals cannot coordinate on local reforms. This might preserve differences in beliefs and norms across regions. (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 premodern cotton textiles on modern outcomes might have been even greater.

Despite a past 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.[56] 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 transforming the cultural belief that women are worth less than men.

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 transform beliefs about women's worth. When women began to earn an income close to or higher than that of men, a shift in cultural beliefs occurred. Cultural beliefs about the worth of women switched from an equilibrium in which women were seen as worth less 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.

[56] 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 premodern cotton textile production. These results are robust to clustering at different geographical levels, matched samples, addressing biases in gazetteer data, different subsamples, using other variables in the 2000 census such as child sex ratio and education, accounting for historical and modern confounders, the inclusion of main determinants of gender norms raised in previous literature and an instrumental variable strategy. Comparing high-value work with lower-value work performed by women, only high-value work has an effect on sex ratio at birth. Accounting for large political and economic shocks after 1840, the effects of premodern cotton textile production remain.

Having cotton textile production in the past is associated with more progressive gender norms and greater daughter preference. Historically, an adaptation in gender norms, in response to the cotton revolution, likely happened by 1600. Places with cotton textile production had lower rates of widow suicide, and stable incomes women could derive from cotton textile production likely played an important role in preventing widow suicide. Given that widows were able to make independent decisions and had more visibility in public space than most other women, I also argue that the presence of economically independent widows might help to shape the image of women as productive members of society. The effects of premodern cotton textile production persisted beyond 1840, and were manifested under different political and economic regimes. At the onset of industrialization in China, premodern cotton textile production is associated with more women working in the industrial sector. Under state socialism, cultural beliefs about women's worth continued to operate in the private domain when the public domain became highly centralized and tightly controlled by the government.

This study raises an important concern that societies lacking high-value work opportunities for women in the past, due to persistence in cultural beliefs about women's worth, 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.[57] To change the belief that

[57]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. Coffman (2014) finds evidence for self-stereotyping influencing an individual's decision to contribute her ideas to a group. A recent study shows that differences in aspirations regarding becoming a law firm partner account for a large share of the differences between the performances of female and male lawyers (Azmat and Ferrer, forthcoming). For a survey on gender differences in preferences

women are worth less than men, technologies and institutions that facilitate the creation of high-value work opportunities for women would be highly beneficial. In addition, this paper also suggests that it is possible for women to obtain a higher status even in a fairly traditional society. 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 women's status in traditional societies.

and psychological traits, see Bertrand (2011).

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For Online Appendix

A Additional Figures and Tables

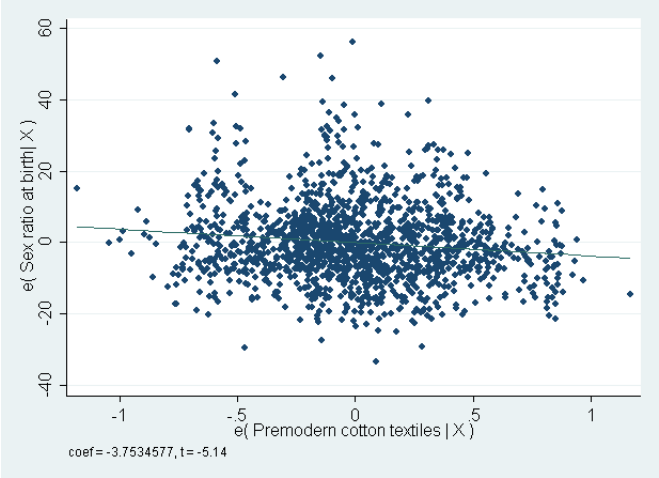


Figure A.I: Partial Regression Plot

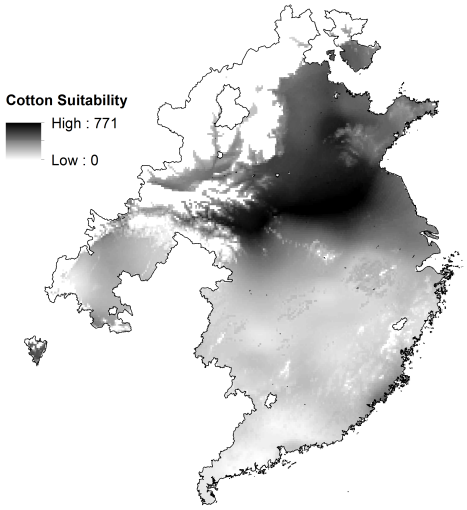


Figure A.II: Agro-Climatically Attainable Yield (kg DW/ha) for Immediate-Input-Level, Rain-Fed Cotton

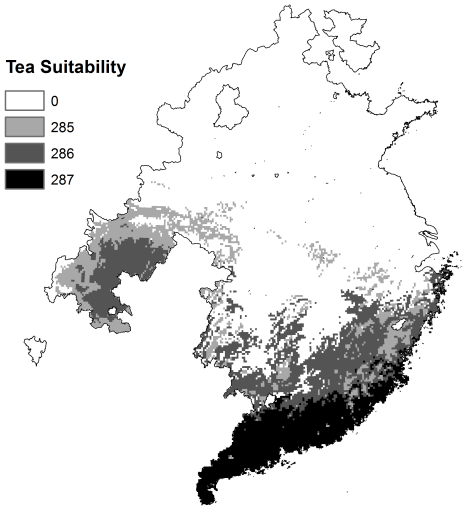
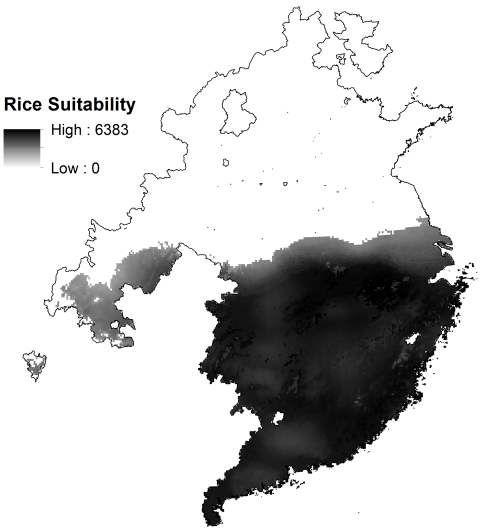
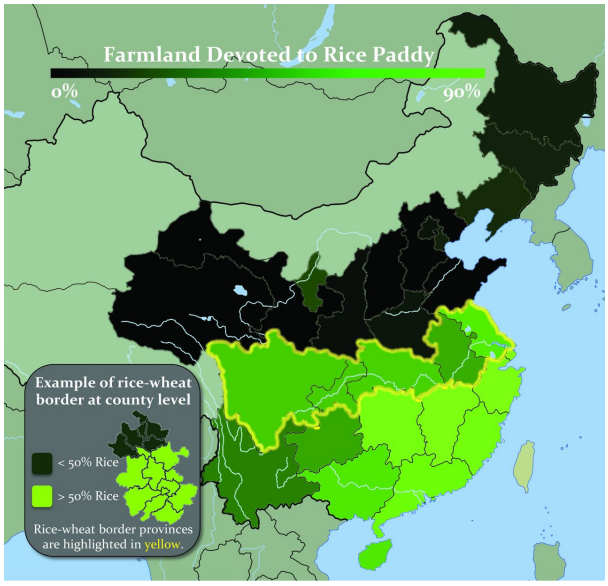


Figure A.III: Agro-Climatically Attainable Yield (kg DW/ha) for Immediate-Input-Level, Rain-Fed Tea



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



b: Farm Land Devoted to Rice Paddy. Source: Talhelm et al. (2014)

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
Premodern cotton textiles	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.
Premodern cotton textiles	0.47	0.486	0	1
Premodern cotton textiles, 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
Premodern cotton textiles	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:					
Premodern cotton textiles	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). The usual definition of China proper refers to the "Eighteen Provinces" system of the Qing dynasty. In terms of modern China it also corresponds to 18 provinces. I also do not include ethnic regions (provinces, prefectures and counties) in my sample, as historically, many ethnic minority groups were outside of the Chinese territory or maintained a great degree of autonomy despite living on the Chinese territory. There are substantial differences in laws and customs between ethnic minorities and Han Chinese. Often, 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 Premodern Cotton Textile Production

In collecting information on premodern cotton textile production, 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.[58] 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 later on. In contrast, late adopters are very likely not represented in Wang's study due to 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 premodern cotton textile production.

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

[58] 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.

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 discard information on the timing and frequency 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 premodern cotton textiles as a indicator variable, neither the timing of the first gazetteer, nor the frequencies of publishing gazetteers should have a substantial impact on my estimates. This is especially true given the continuity in production once a place began to produce cotton textiles.[59] Suppose a prefecture did not publish any gazetteers until 1800, but began its cotton textile production far earlier than 1800, using a binary variable for premodern cotton textile production 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. As long as production is not reversed, a gazetteer in later years will adequately reflect the historical presence of cotton textile production. It is of less importance when a prefecture began to publish gazetteers, if a binary variable is used to code premodern cotton textiles. A similar logic applies to "survivorship bias". As in general, gazetteers published in later years were more likely to have survived. Had places been exposed to a different number of shocks, or had differential ability to cope with shocks, gazetteers published in the more recent past are less likely to be subject to shocks and shock-induced loss of gazetteers. By discarding the timing dimension, I can effectively reduce the exposure to "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 premodern cotton textile production 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

[59] A likely exception is Fujian Province. Fujian is a coastal province that is rugged and mountainous. It relied heavily on ocean trade. While the textile industry thrived in earlier times, cotton textiles became less common in Fujian after the Ming Dynasty, likely due to the suspension of ocean transportation.

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 premodern cotton textile production derived from prefecture- and county-level sources.

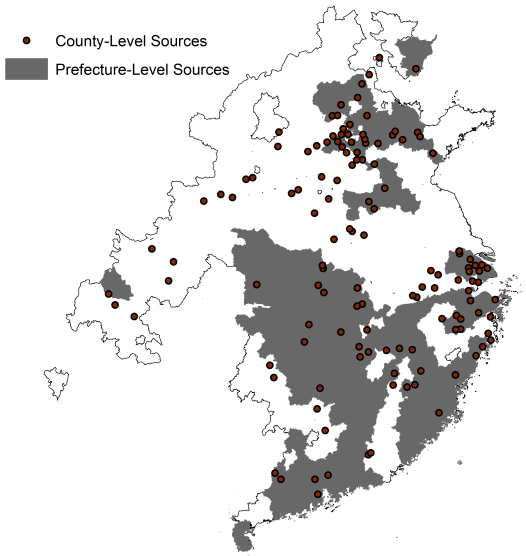


Figure A.V: Premodern Cotton Textile Production:
County- and Prefecture-Level Sources

Historically, counties enjoyed a great degree of political autonomy (Qu, 2003, pp.11-15, 179-201, 248-255), which was conducive to the formation of an independent cultural tradition. Such 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 tended to evolve 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 it occupied. The value of premodern cotton textile production for a modern administrative unit depends on the percentage of area exposed to premodern 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

[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.

premodern cotton textile production. This method could produce dependent 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 dependent 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 premodern cotton textiles 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 premodern cotton textiles. 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 premodern cotton textiles.

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.

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 can apply to other goods as well. To account for the general benefit of proximity 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 built 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 better maintained in the Ming Dynasty. This may be partly due to the need to transport cotton textiles. 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

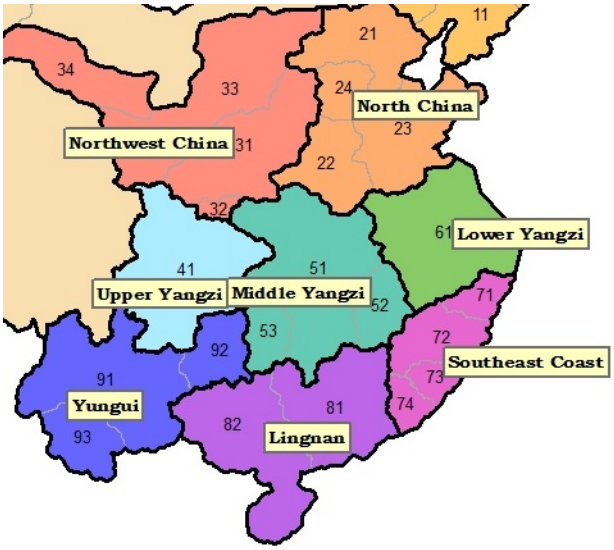


Figure A.VI: Socioeconomic Macroregions
Source: G. Skinner, Henderson, and Berman (2013, p.215)

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). 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." Similarly, American philosopher Mary Ann Warren (1985) considers sex selection to be 'invariably motivated by sexist beliefs".

In the United States, on the eve of ultrasound technology becoming widely available for sex selection, 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). 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.

Historically, in some parts of the world, infanticide were prohibited. In Roman Empire, infanticide was punishable by the death penalty by the end of the fourth 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 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

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

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 premodern cotton textile production and local access ultrasound scanners. However, this is less of a problem for my study, as 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 premodern cotton textile production, 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

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).

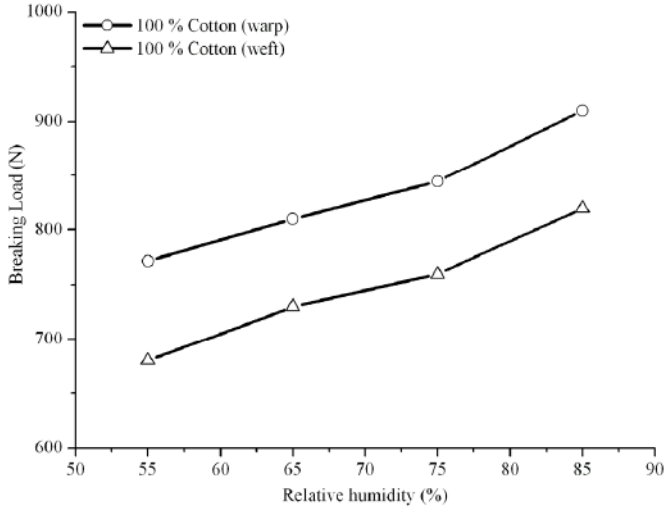


Figure A.VII: Tensile Strength of Cotton at Different Relative Humidity Values.
Source: Iqbal et al. (2012)

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

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 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

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

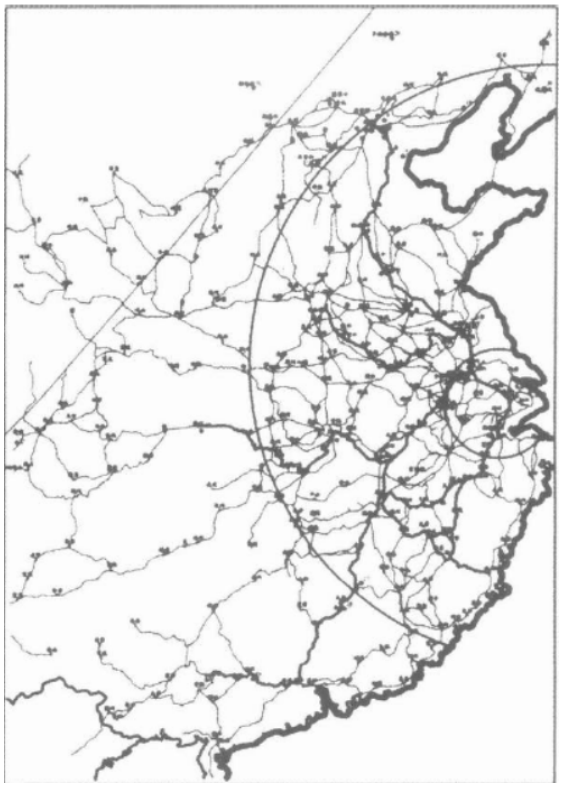


Figure A.VIII: National Market in Late Imperial China.
Source: Fun, 1993

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 premodern cotton textile production.

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 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.

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
Premodern cotton textiles	-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
	Panel B: Probit Dependent variable: premodern cotton textiles			
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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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-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 premodern cotton textile production 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-/prefecture-city level. In case there are other types of correlations between observations at a higher geographic level,

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

	Dependent variable: sex ratio at birth					
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of Dep. Var.	118.6	118.6	118.6	118.6	118.6	118.6
Premodern cotton textiles	-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 premodern cotton textiles 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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.

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

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.

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 premodern cotton textile production, 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

One concern is whether counties self-selected into premodern 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 net-

Table A.VIII: Premodern Cotton Textiles and Sex Ratio Imbalances: Matching

	Dependent variable: sex ratio at birth					
	(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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

work, 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 premodern cotton textiles 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 norms, i.e. counties with less gender equality in the counterfactural are more likely to have a history of cotton textile production.

E.4 Biases in Gazetteer Data

Table A.IX: By Gazetteer Frequency

	Dependent variable: sex ratio at birth						
	(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
Premodern cotton textiles	-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)	
Premodern cotton textiles						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 premodern cotton textiles 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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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 premodern cotton textile production 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 number of premodern cotton textiles and county-level gazetteers is added. In both cases, coefficients of interest remain similar to baseline estimates. The interaction term between premodern cotton textiles and the number of county-level gazetteers 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 is 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 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 premodern cotton textiles is actually far smaller for the Yangtze Delta. This is likely due to a a high level of preexisting gender egalitarianism in the region, and a higher level of development in general, which is also indicated by the negative and significant coefficient estimate of the Yangtze Delta dummy. In addition, I look at counties with different rates of migration. Historically, labor mobility was low due to the long-standing clan system. From the 1990s on, the speed of migration has increased. Gender norms in the less developed regions of China could become more entrenched if more progressive individuals are

[63] To note, information on premodern cotton textile production 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
Premodern cotton textiles	-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)				
Premodern cotton textiles		3.110**				
× Yangtze Delta		(1.285)				
Net in-migration				-1.274*	-13.61	
				(0.705)	(8.432)	
Premodern cotton textiles					12.46	
× Net in_migration					(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 premodern cotton textiles 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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more likely to move to more developed areas. Hence my results could be biased if past locations of cotton textile production 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 interact my treatment 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.

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 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 the age 1-4, sex ratio of the age 5-9. I find in Table A.XI, coefficient estimates are of a similar percentage of, as well as move in the same direction as the mean of the sex ratio at birth. Overall, I find premodern cotton textile production affects the cohorts born after 1990—when ultrasound screening became widely available— in a consistent manner. 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 premodern cotton textiles and sex ratio at birth revealed by the 2000 census is unlikely just a fluke or a mere artifact of

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

	Dependent variable: sex ratio		
	(1)	(2)	(3)
	Aged 5 to 9	Age 1 to 4	At birth
Mean of Dep. Var.	114.8	121.5	118.6
Premodern cotton textiles	-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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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
Premodern cotton textiles	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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

underreporting of female newborns.[64]

Female and Male Education Table A.XII examines alternative gender outcomes from the same census. I find that premodern cotton textile production is also positively associated with women's educational attainment. As gender-specific economic opportunities are already

[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 gender inequality. Unregistered individuals have limited access to most public goods, such as education and medical services.

controlled for in the regression, I interpret this mainly as evidence for underinvestment in girls' education by their parents influenced by cultural beliefs about women's worth. In 2000, premodern cotton textile production 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 men's years of schooling. In column 3, I replace women's years of schooling with men's years of schooling, and I do not find a significant effect, and the coefficient is slightly negative (-0.0153). This shows that premodern cotton textile production has a very specific effect on women, and does not reflect simply a general effect of development.

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 progressive gender norms. 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 only 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.

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
Premodern cotton textiles	-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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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 persistence in state presence, and historical state presence might have influenced

both premodern cotton textile production and modern state capacity. Modern state capacity can influence gender outcomes.[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 estimate of premodern cotton textiles 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 premodern cotton textiles could shape gender outcomes 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, premodern cotton textile production 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 premodern cotton textile production on sex selection is partially, but very limitedly, mediated by modern textile industry.

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.

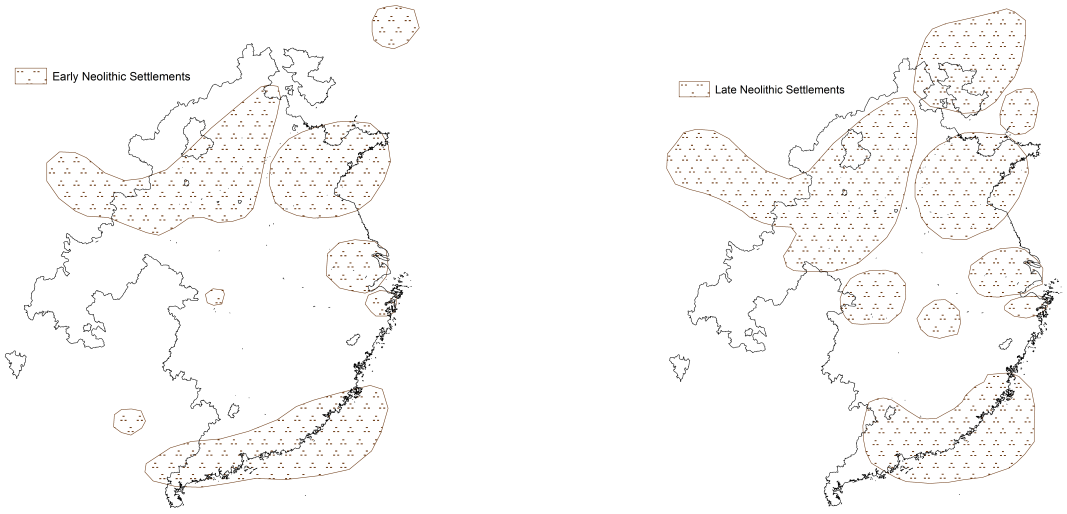
The Neolithic Revolution The intensification of agriculture is considered to have led to the deterioration of women's status (Hansen, Jensen, and Skovsgaard, 2015). *Years since the Neolithic Revolution* is often used to proxy for exposure to intensification of agriculture but is only known at the country 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.

[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.

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
Premodern cotton textiles		-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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$



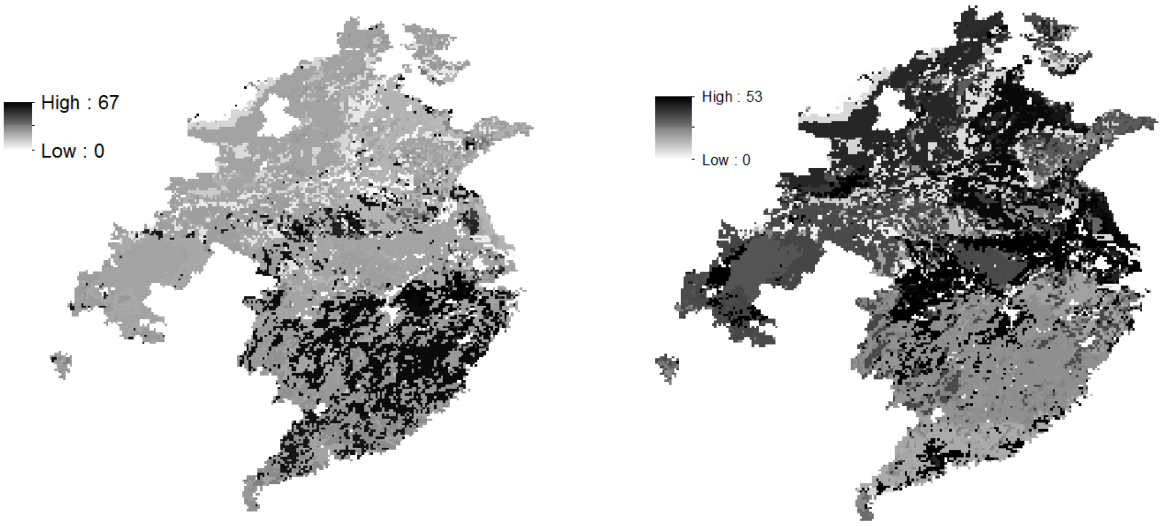
a: Early Neolithic Settlements b: Late Neolithic Settlements

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 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

[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

the reduction is rather small and there is no change in the level of statistical significance.

The null effect of soil texture on sex ratio at birth is not too surprising. First, it is likely that soil texture only affects sex selection through the economic channel, 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 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 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 group 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 premodern cotton textile production do not go away even under a strict socialist regime, I turn to an analysis of how state socialism interacted with premodern cotton textile production. 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.XV suggests that premodern cotton textile production 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 premodern cotton textiles for 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 premodern cotton textiles 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 led to greater productivity. The production capacity of individual textile producers began to exceed their and their family members' clothing needs. 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 constraints than 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] By the late Ming period, however, market exchange of cotton textiles became more prevalent as a market economy developed further with the "single whip" reform. A booming

[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.XV: Wife Heading the Household: A Cohort Analysis

Dependent variable: wife			
	(1)	(2)	(3)
Mean of Dep. Var.	0.0589	0.0589	0.0589
Premodern cotton textiles × born before 1935		0.256**	
		(0.117)	
Premodern cotton textiles × born before 1949			0.115
			(0.123)
Premodern cotton textiles × 20 to 24	0.130		
	(0.571)		
Premodern cotton textiles × 25 to 29	0.205		
	(0.570)		
Premodern cotton textiles × 30 to 34	0.170		
	(0.582)		
Premodern cotton textiles × 35 to 39	0.175		
	(0.573)		
Premodern cotton textiles × 40 to 44	0.155		
	(0.583)		
Premodern cotton textiles × 45 to 49	0.118		
	(0.592)		
Premodern cotton textiles × 50 to 54	0.261		
	(0.588)		
Premodern cotton textiles × 55 to 59	0.427		
	(0.571)		
Premodern cotton textiles × 60 to 64	0.378		
	(0.579)		
Premodern cotton textiles × 65 to 69	0.540		
	(0.566)		
Premodern cotton textiles × 70 to 74	0.683		
	(0.576)		
Premodern cotton textiles × 75 to 79	0.474		
	(0.593)		
Premodern cotton textiles × 80+	0.769		
Premodern cotton textiles	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 premodern cotton textiles 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 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

money economy promoted domestic trade and expanded the market for cotton textiles.[69] The production of cotton textiles became increasingly commercialized and specialized. 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.XVI.

Table A.XVI: Domestic Trade Just before 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)

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 forced 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

[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.

[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.

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 A Comparison to the Cotton Textile Proto-Industry in England

Premodern cotton textile production 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.4 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.

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

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.5 Neo-Confucianism and Widow Suicide

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

[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.

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.

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[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).

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