The Economic Motives for Foot-binding*

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Abstract

What are the origins of gender-biased social norms? This paper presents a unified theory to understand foot-binding – a long-standing custom that reshaped the feet of girls in historical China – and investigates its adoption dynamics driven by a gender-asymmetric mobility system (the Civil Examination System). The exam system marked the transition from heredity aristocracy to meritocracy, which generated a more heterogeneous composition of men compared to women, triggering intensive competition among women in the marriage market. Embodying both aesthetic and moral values, foot-binding was gradually adopted by women as a social ladder, first by the upper class and later by the lower class. However, since foot-binding impedes non-sedentary labor but not sedentary labor, its adoption in the lower class exhibited distinctive regional variation: it was highly prevalent in regions where women specialized in household handicraft, and was less popular in regions where women specialized in intensive farming, e.g. rice cultivation. Empirical results with county-level Republican archives on foot-binding are consistent with theoretical predictions.

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"*Foot-binding as a ladder of success for women thus mirrored the fate of the civil service exam, a similar vehicle for men...Foot-binding was useful for social climbing, not mountain climbing.*"

- Dorothy Ko, *Cinderella's Sisters: A Revisionist History of Footbinding*, *Chapter 6,* 2005

1 Introduction

Gender-biased social norms reflect the evolution of gender inequality. Carrying significant disutility for women, gender-biased social norms have existed widely across the globe and in different historical periods, with profound impacts on women's economic, social, physical, and psychological well-being. For instance, as a cruel procedure that violates a woman's rights to health and security, female genital mutilation (FGM) has a long history and still persists in Africa, the Middle East and Asia (WHO, 2012). In other historical contexts, we also observe corsets in Victorian Europe and foot-binding in historical China. These practices share striking similarities: all involving devastating body modifications, all practiced at young ages for girls, all having profound marriage market implications, and all carrying significant individual and social costs. If we extend our horizon beyond cruel body modifications, other gender-biased norms may also harm women's welfare, such as female infanticide and the high dowries in post-modernization India (e.g. Bloch and Rao 2002, Anderson 2003, 2007). Given that some of such norms were successful eliminated (corsets and foot-binding) while others persist (FGM and high dowries in India), one may wonder about the origins of gender-biased social norms, as well as the institutional and economic factors that determine their emergence, persistence, and disappearance. This paper sheds light on these questions by examining foot-binding, a representative gender-biased social norm in historical China that had been successfully eradicated in the early 20^{th} century.

As a painful practice in historical China, foot-binding targeted girls whose feet were re-shaped systematically during their early childhood. Originating from a female dancer in imperial palace during the Five Dynasties (907-960), foot-binding persisted for nearly a millennium in historical China. Initially appreciated as a major icon of feminine beauty, from the early 20^{th} century onwards, it was increasingly viewed as a brutal cultural practice reflecting the oppression of women by a masculine-dominated society. Considerable efforts were made by the government and social activists to eradicate the practice (e.g.

Yang, 2012), and scholars from multiple disciplines have provided perspectives to explain its popularity. Many explanations focus on a specific aspect of foot-binding, but few explains the timing of its emergence and decline, as well as regional and class differences in its prevalence, within a consistent framework.

This paper presents a unified theory of foot-binding that explains the variation of its practice over time, among classes, and across regions. Foot-binding is modeled as a premarital investment made by girls' parents for marriage market competition. The heart of our theory is to relate such investment decisions with the dynamics of a gender-specific social mobility system – the Civil Examination System (in Chinese, the *Keju*, 607-1905). Briefly, the exam system triggered a transition from heredity aristocracy to meritocracy, under which system talented males could climb up the social ladder by passing exams while those who failed the exams would move downwards. As a consequence, the exams introduced greater social mobility, and resulted in a more heterogeneous composition of men compared to that of women on marital quality. This induced greater premarital investments by women for better marriage opportunities and against potential downward mobility. Foot-binding, as a package embodies both aesthetic and moral values of women, was adopted to differentiate themselves in the marriage market and served as a social ladder for women to climb up.

In addition to the marriage market value of foot-binding, we also consider the labor opportunity cost of foot-binding by examining different types of women's labor in diverse agricultural regimes. Given that foot-binding deforms women's feet, it sharply limits physical mobility thus precludes them from engaging in intensive non-sedentary activities, while having much less of an effect on sedentary activities such as household handicraft production. Therefore, among lower class women who played an active income-earning role, foot-binding prevalence exhibited regional variations driven by different agricultural regimes. In particular, foot-binding of lower class women was highly prevalent in regions where women specialized in sedentary labor (e.g. household handicraft), and less popular in regions requiring labor-intensive farmland work (e.g. rice cultivation).

Guided by our baseline model, three extensions were presented. The first adopts a three-layer hierarchy of exam results instead of a binary structure, reflecting high, medium and low rankings in the exams. Second, we take foot-binding intensity as a continuous choice to explain variation in the size of bound feet (i.e. large versus small). Finally, we introduce multiple tools for marriage market competition, allowing foot-binding and dowry payments to coexist. Results from our extensions are robust to the baseline model, yielding richer implications for explaining differences in foot-binding practice.

Next, to test the model predictions on marriage market, we draw upon both quantitative and qualitative sources from historical archives, anthropology, and archaeology. In particular, we collect county-level foot-binding prevalence from Republican archives, and examine how marriage market prospects generated by the exam system could affect foot-binding. To this purpose, we employ regional variation in the exam quota assignment at county level, so as to capture men's region-specific mobility through the exams and women's marriage market prospects (Kun et al., 1899). With an instrument variable that drives exogenous variation in quota allocation at county level, we find that exam quotas predict a higher incidence of foot-binding at the county level significantly, with a one standard deviation increase in exam quota leading to a 16.8 percentage point increase in the probability of foot-binding. Further, using archaeological findings on three pairs of foot-binding shoes, we analyze both the locations and life histories of their owners during the Song. Specifically, we show that foot-binding shoes occurred in regions with a high density of officials through exams; regarding marital outcomes, all three owners maintained their status, among which two achieved marrying up.

To empirically test labor opportunity cost and foot-binding, we combine the cross-sectional data on county-level foot-binding prevalence with the agricultural suitability index developed by GAEZ (Global Agro-Ecological Zones, FAO) to test whether labor-intensive crop cultivation can be protective for women in terms of foot-binding. We find that a greater suitability for rice (a major labor-intensive crop) relative to wheat predicts less foot-binding prevalence, while a greater suitability for cotton (a dominant high-value handicraft fiber) predicts more foot-binding intensity. In particular, a one standard deviation increase in relative rice suitability leads to a decrease in probability of foot-binding prevalence by 7.3 percentage points, while the same change in cotton suitability increases such probability by 17.8 percentage points. As an additional check to rule out potential confounding factors, we use a qualitative example of spatial discontinuity in Jiangsu Province to support our causal interpretation of this relationship in Appendix 8.7.

Our study makes contributions to several different literature. First, it contributes to understanding gender norms, by showing that gender-asymmetric mobility system can generate customs that carry high disutility for women[1]. Previous scholarly work has explained the origins of gender norms from agricultural technology (e.g. Boserup, 1970; Qian, 2008; Alesina et al., 2013; Xue, 2017; Becker, 2018), historical demographic composition and shocks (e.g. Grosjean and Khattar, *forthcoming*; Teso, *forthcoming*), wars (Acemoglu et al., 2004; Fernandez, Fogli, and Olivetti 2004), education, and technology

[1]See Giuliano (2017) for a summary on historical origins of gender norms.

(e.g. Goldin 1990, Goldin and Katz 2002), just to name a few. In a broader sense, our paper illustrate the linkage between social mobility system, as a type of institution, and gender norms. Regarding this linkage, Anderson (2003) illuminates a classical case which caste system in India in association with the modernization process produced dowry escalation.

Second, our work contributes to the literature on the economics of marriage (e.g. Becker, 1973, 1974), premarital investments (e.g. Peters and Siow 2002; Iyigun and Walsh, 2007; Chiappori et al. 2009; Bhaskar and Hopkins 2016), and marriage institutions (e.g. Tertilt 2005; Mariani 2010; De la Croix and Mariani 2015). While this literature provides rich theoretical insights[2], our paper adds to this strand of literature by zooming in a specific form of premarital investment – foot-binding – that non-monetary utility transfers can be used to compete for marital benefits and insure against the risk of downward mobility[3].

Third, our work contributes to the growing literature in cultural economics, including Carvalho's (2013) explanation of the New Veiling movement among Muslim women; Chesnokova and Vaithianathan (2010), Bellemare et al. (2015), Becker (2018), Poyker (2018) on the motives and persistence of FGM; and studies by Rao (1993), Edlund (2000) and Anderson (2003, 2007) on dowries in India. In this regard, our paper facilitates understanding of how destructive gender-biased cultural practices can arise, considering similar cultural practices such as corsets in the Victorian period in the US and Europe[4]. While foot-binding and corsets have disappeared, understanding the evolution of foot-binding is helpful to policy makers seeking to eradicate harmful customs such as FGM and high dowries.

Last but not least, this paper contributes to the literature on foot-binding by providing a unified economic theory of the practice, and a quantitative assessment using a new historical data set. It builds upon previous studies of foot-binding have come from different disciplines such as history, anthropology (e.g. Blake, 1994; Gates, 2001; Bossen et al., 2011; Brown et al., 2012; Yang, 2012; Bossen and Gates, 2017), sociology (e.g. Mackie, 1996), and literature (e.g. Wang, 2002; Ko, 2005), all of which provide insights and evidence[5]. In the economic literature, the earliest analysis of foot-binding is from Veblen

[2]In particular, Hoppe et al. (2009) provided general theoretical insights that asymmetries in signaling between the two sides of the market can be explained by asymmetries in heterogeneity.

[3]If we consider foot-binding carries chastity norms, our work echoes Mariani (2010) who takes women's chastity as a special form of premarital investment.

[4]The Victorian period also was a peak period for gender-asymmetric social mobility (e.g. Galor and Moav, 2006).

[5]Previous explanations of foot-binding emphasized on its aesthetic, erotic, and biological motives

(1899), who considered foot-binding to be a parallel phenomenon to Victorian corsets in Europe and America, where in both cases the investment was a symbol of social status. Another discussion of foot-binding is by Cheung (1972), who argues that it reduces the cost of enforcing property rights over wives. However, both of these studies are limited in that neither systematically reviewed the stylized facts of foot-binding and cannot explain foot-binding's temporal and regional variations.

The rest of this paper is organized as follows. Section 2 provides a brief review in foot-binding and the Civil Examination System, and Section 3 presents our theory. Section 4 introduces archives and shows empirical results, and Section 5 concludes.

2 Background

2.1 Foot-binding: Stylized Facts

Foot-binding targeted girls whose feet were systematically reshaped during early childhood. The process is often initiated and practiced by mothers or grandmothers and can last for years, during which time the bones and muscles were gradually modified. A pair of bound feet carries lifetime painfulness, and is often accompanied by other types of health issues (e.g. infections) and even disability.

To present the stylized facts of foot-binding, we reviewed multiple sources and present a summary in Appendix 8.1. Four stylized facts emerge here: (1) Time variation: while scattered instances of foot-binding can be found in earlier historical periods, it did not gain popularity until the post-Song period, and faded into the past in the early 20^{th} century[6]; (2) Class variation: foot-binding was first adopted by the upper class and later

(e.g. Yao, 1936; Levy, 1960; Cheung, 1972; Mackie, 1996; Ko, 2005), that foot-binding prevailed as a result of people's preference on women's beauty and purity. Among cultural explanations, three theories explained it as a consequence of the revival of Confucianism (Chen, 1928), or as a way to consolidate the patriarchal kinship system (Greenhalgh, 1977), or a dressing code to reflect ethnic identity by the Han Chinese women (Ebrey, 1990). The existing closest theory from anthropological perspective revealed the linkage between women's household handicraft and foot-binding (e.g. Ebery, 1990; Mann, 1997; Gates, 2001; Bossen et al.,2011); in particular, Bossen and Gates (2017) argued that foot-binding was adopted by the family to boost the economic contribution of girls in household production. However, while each of the theories is successful in explaining a certain facet of foot-binding, accounting for its stylized facts by time, region, and class is still a problem unsolved.

[6]For the earliest evidence of foot-binding, the greatest consensus is that it emerged during the Five Dynasties (907-960) (e.g., Ko, 2005). *Yao Niang*, who was a dancer of the palace, wrapped her feet tightly to enhance her daintiness. Starting from the Song dynasty (960-1279), foot-binding gradually gained popularity among upper class women, and diffused from the upper class to the lower class during

by the lower class, and its prevalence of the upper class dominated that of the lower class; (3) Regional variation: among lower class women, the prevalence of foot-binding varies by region. As illustrated by Figure 1, foot-binding was most prevalent in Northern China, while it was much less prevalent in Southern China, especially in the Pearl River Delta [7]; (4) Size variation: the higher the social status, the more tightly bound the feet (Qian, 1969). In addition, within the upper class, the size of feet grew smaller over time. [8].

2.2 The Civil Examination and Mobility

This section provides a brief review of a major gender-biased institutional shock in historical China: the Civil/Imperial Examination System[9], which was a meritocratic elite recruitment system that triggered changes in social mobility. The system was initiated during the Sui (581-618) and the Tang (618-907), consolidated and expanded during the Song (960-1276) and fully institutionalized during the Ming (1368-1644) and Qing (1644-1911). During the post-Song period, the system was the most important channel for elite recruitment.

Several features of the exam system are worth highlighting. First, only men were eligible to participate in the exams[10], regardless of family background or age. Second, the exams were hierarchical. Specifically, during the post-Song period, there were three levels of exams including: (i) the Licensing exam at the prefecture level, those who passed the exam were entitled as *Literati*; (ii) the Qualifying exam at the provincial level, where those who passed were entitled as *Recommended man*; (iii) the Academy exam, where those earned the title *Presented Scholar*. Third, the scale and selection criteria of the exams changed over time: prior to Tang (618-907), only a very limited fraction of officials were selected by the exams, while the Song (960-1279) witnessed a significant improvement

the Ming and Qing.

[7]This pattern was widely documented by scholars (e.g. Qian, 1969; Hu Pu-An; Ko, 2005; Davin, 1976; Turner, 1997). Another piece of evidence illustrating the intensity of foot-binding in Northern China was the *Bound Feet Beauty Contest* (in Chinese, *Sai Zu Hui*, see Appendix Figure A3).

[8]While most Han Chinese women intensively practiced foot-binding, foot-binding among ethnic minority women displayed heterogeneity. For instance, minorities living in Canton, Fujian and Yunnan do not bind their feet, yet some Manchurian and Hui women in Gansu practiced foot-binding.

[9]For a general description of the examination system, see Magone (2015). On the exam system and changing social mobility as a consequence, see Ho (1962), Hartwell (1982), Elman (2000, 2013), and Shiue(2017).

[10]Except for the exams hosted by the Taiping regime during their rebellion (1851-1864) that permitted women to take the exams, which is geographically and temporally very limited.

procedural fairness and recruitment size[11] (Chafee,1995). Forth, regarding regional variation, the exam was regulated by a quota system, which was well established during the Qing. Corresponding to the hierarchical exam structure, the quota allocation was also hierarchical at each level by setting up the number of successful candidates per exam, therefore regulated elite recruitment across regions.

Social Stratification. The exam system generated a social hierarchy and deeply affected social mobility in historical China. Appendix Figure A1 provides an illustration of this social ladder based upon Chang (1955), mapping each level of exam degree holders to their corresponding positions in the social hierarchy. The upper class, including government officials and gentries, enjoyed economic, legal, and social privileges and prestige (Chang, 1955). The income disparity between class was notable: the ratio of average annual income of gentry to that of a commoner male labor varies from 1.5 to 36, depending on gentry's occupation[12].

Social Mobility. There has been rich studies of the extent to which the exam system has affected social mobility[13], revealing a profound effect ofthe exam system. While during the Tang, below 10% of the bureaucrats were recruited from the exam system, this share climbed up to more than 50% during the Song. By looking into the top level elite structure, 98 families/clans produced 369 chancellors during the Tang, while the 134 chancellors during Song were scattered among 126 families/clans. Further, to quantify the social mobility across dynasties, we construct the surnames fractionalization index of upper class men as a measure of social mobility using the China Biographical Database Project (CBDB)[14], where the upper class is defined as officials, scholars, and other categories of celebrities. We hypothesize that a concentrated distribution of surnames indicates relatively restricted mobility, while a high level of fractionalization of surnames captures greater mobility. Appendix Figure A2 illustrates a jump in the fractionalization index during the Song compared to previous dynasties.

[11]During the Song, the system generated almost 100,000 Presented Scholars, around 15 times the number recruited during the Tang dynasty.

[12]By examining the aggregate income profile of the 19^{th} century elite, Chang (1962) illustrated that the major income sources of the upper class included officeholding in the bureaucracy, landownership, mercantile activities, gentry services, and so forth. Appendix Table A2 presents the relative income of gentry versus commoners.

[13]For reference in social history, see Ho (1962), Hartwell (1982), Hymes (1986) and Elman (1991, 2000). For recent studies in the field of economic history, see Shiue (2017).

[14]The CBDB (version: 2015-03-18) is an relational database with biographical information about approximately 360,000 individuals before the early twentieth century.

2.3 Civil Examination and the Marriage Market

The establishment of Civil Examinations introduced profound changes to the marriage market as well. In brief, the exam system break the political monopoly among the powerful clans, and introduced both upward and downward mobility. For upward mobility, individual exam achievements became the major channel of obtaining social status. In the mean time, family social status were no longer life-time secured: only good exam performances of male descendants could sustain family status, not mentioning any shocks in emperor's preferences or political struggles could result in demotion and a loss of status. Facing such changes in mobility, families developed different strategies in raising boys and girls: they enhanced educational investment of boys, and enhance premarital investment of girls[15]. As a result, marriage as a tool in sustaining family social status became increasingly important (Xu, 2009, Tao 2001).

We draw upon a rich pool of personal life history studies during the Song dynasty and observe three aspects of changes in the marriage market (e.g. Ebrey, 1993, Hymes, 1986, Xu, 2009, Tao 2001). First, a transition took place from single dimensional matching – when only family/clan status matters – to multidimensional matching, when both family background and individual talent/exam achievement mattered when selecting grooms, while both family status and beauty mattered when selecting potential brides (Zhang, 1989). Second, the marriage market matching outcomes also changed: prior to the Song, powerful clans were interconnected through marriages and marital homogamy dominated (Zhang, 2003); after the Song, the degree of homogamy decreased and the husbands of upper class women became more diversified in terms of their original family background (i.e. Tao 2001, Xu, 2009). Finally, an unique phenomenon emerged during the Song – "grabbing" successful candidates as sons-in-law upon the exam releasing.

To quantify the scale of the exam system relative to the marriage market, we provide a calculation on the entry level exams during the Qing[16]. Appendix Table A3 provides both stock and flow calculation based on Chang (1955), bearing mild assumptions on

[15] A folk ballad vividly described this set of strategy, specifically regarding foot-binding: "*Never coddle a boy in his study, and never coddle a girl in her feet*". (Zhang 2015)

[16] We consider the entry level exams for two reasons: first, according to Chang (1955), among the *Literati,* 63% were at marriageable ages of 16-25, which was the most relevant group at the timing of marriage market matching; second, men can only obtain higher level degrees (i.e. *Recommended Men* or *Presented Scholars*) when granted with the *Literati* degree, and the higher level degrees came at older ages (i.e. 30-40) which beyond the usual marriage market matching time span. As an illustration, Appendix Figure A4 shows folk ballads on how foot-binding was used for the competition to be *Literatis*' wives.

population structure[17]. The stock measure captures the proportion of gentries (those with at least a degree of *Literati*) among population, varying from 0.3% (Anhui) to 1.3% (Yunnan). The flow measure quantifies the number of men who were newly granted with a degree of *Literati* each year among marriageable ages, varying from 0.07% (Hubei) to 0.38% (Yunnan). Given the numbers restrict "talented grooms" to degree holders, being "talented" at young ages perceived by the bridal families was more flexible, including the number of trials one had made for the exams and their ranking per exam. In extension and discussion of theory (Section 3.5.2 and 3.5.3), we discuss how a more hierarchical structure of ability and polygyny can amplify the effect of the exams.

3 The Theory

In this section, we model foot-binding as a premarital investment by the bride's family, and discuss how a gender-asymmetric social mobility system triggered the evolution of foot-binding in the upper class and lower class.

Setup. We consider a society with two classes: the upper class and the lower class, denoted by $\tau \in \{u,\ l\}$. The upper class occupies share μ of the population, with the remainder, $(1-\mu)$, in the lower class. We assume $\mu < \frac{1}{2}$ as upper class occupies a minority in population. We normalize both male and female population to 1, and assume the sex ratio to be 1 and identical across classes[18]. We index individual women by i and individual men by j, respectively.

Marriage. Marriages decisions were made by parents. We assume that matching between brides and grooms is one-to-one[19]. To define the quality of brides and grooms, we posit two attributes – family status θ and individual ability γ, where $\theta, \gamma \in \{h, l\}$, and $h > l > 0$. We assume that the ability distribution is independent of class and gender, and the proportion of individuals with high ability h revealed by the exams is p. We further assume that $p < \mu$, reflecting the fact that the examination is highly selective and elite recruitment through the examination system is not perfect.

[17]For sex ratios among the population, we take a lower bound assumption of the sex ratio to be 110 men per 100 women and an upper bound to be 130 respectively, and assume that 16-25 account for 20% of the total population.

[18]While the actual sex ratio of male to female was greater than one, assumptions about sex ratios do not drive our main theoretical results. We further discuss this assumption in Section 3.5.

[19]We explicitly focus on the market for wives, not that of concubines. The marriage markets for wives and concubines are separated and different by nature. To marry a wife, a formal marital procedure was required, and a wife enjoyed more solid economic and legal status than concubines. Section 3.5.3 discusses relaxation of this assumption and the case of polygyny.

Specifically, we assume the quality of a man q_j is the weighted average of his family status θ_j and ability γ_j, where his relative weight for ability is α^G, so that $q_j = \alpha^G\gamma_j + (1-\alpha^G)\theta_j$. The quality of a women q_i is determined by her family status, ability and her labor value which is affected by foot-binding, thus $q_i = \alpha^B\gamma_j + (1-\alpha^B)\theta_j + \beta_{\tau_j}(\mathbb{I}_{FB})l$. Here α^B is the relative weight on ability for brides, l is women's labor value, and $\beta_{\tau_j}(\mathbb{I}_{FB})$ stands for women's labor value as a function of foot-binding as well as future husband's social class τ_j. In particular, we assume that $\beta_u = 0$, so that wives of upper class men have no laborious role in household. By contrast, for wives of lower class men, their labor value matters and affected by foot-binding, thus $\beta_w|_{\mathbb{I}_{FB}=0} = \beta_0 > \beta_w|_{\mathbb{I}_{FB}=1} = \beta_1 > 0$. This captures the fact that foot-binding impedes labor. Further, since the return to women's intellectual ability for most historical episodes we discuss was low (women cannot be officials or be involved in commerce), we assume the ability weight for women equals zero, i.e. $\alpha^B = 0$. Hereafter we suppress the notation of α^G to be α, standing for men's meritocracy parameter. Denote the matching value for bride i marrying groom j as $v(q_i, q_j)$, we have $v(q_i, q_j) = v\left(\theta_i + \beta_{\tau_j}(\mathbb{I}_{FB})\, l,\ \alpha\gamma_j + (1-\alpha)\theta_j\right)$.

Taking the benefits and costs of foot-binding for both grooms and brides into account, the total marriage benefit for each side in the market is the following:

$$\text{Bride: } V_B(q_i, q_j, \mathbb{I}_{FB,i}) = v\left(\theta_i + \beta_{\tau_j}(\mathbb{I}_{FB,i})\, l,\ \alpha\gamma_j + (1-\alpha)\theta_j\right) - \mathbb{I}_{FB,i}C; \text{ and}$$

$$\text{Groom: } V_G(q_i, q_j, \mathbb{I}_{FB,i}) = v\left(\theta_i + \beta_{\tau_j}(\mathbb{I}_{FB,i})\, l,\ \alpha\gamma_j + (1-\alpha)\theta_j\right) + \mathbb{I}_{FB,i}B.$$

Foot-binding creates disutility for brides (denoted by C) and affects their labor value; on the other hand, it serves as a lump-sum utility transfer to grooms (denoted by B).

Foot-binding. Foot-binding decisions by parents were made at girl's early childhood (i.e. age 5 to 12), and marriage market matching took place in a later stage (i.e. 16-25). The bride's family used the option to bind daughter's feet to compete for better marriage opportunities and insure against downward mobility in the future[20]. Regarding the value of foot-binding, men's preference revealed it as a combination of appreciation of women's beauty and virtue. For its aesthetic value, there exists a long-standing admiration of women's small feet and elegant gait, traceable in Chinese poems and prose[21]. In addition, foot-binding was also considered as carrying a "*vector of status*" , as a symbol of elegance,

[20]There exist other tools for marriage market competition, i.e. dowry. Section 3.5.2 provides an extension of how women used both foot-binding and dowries for competition.

[21]In addition, foot-binding was also considered to bear erotic values (Howard Levy, 1966). See Zhang (2015) for a summary of poems and prose on the appreciation over foot-binding.

good breeding and a mark of status and virtue (e.g. Mann, 1997, Ko, 2005, Bossen and Gates, 2017). Since foot-binding is a painful process for women to undertake, well-shaped and tiny bound feet also help to reveal their endurance, obedience and submissiveness[22]. Taken together, as a package of beauty and women's feminine virtue, foot-binding captured the key elements of men's moral and aesthetic appreciation of women. In the model, we assume foot-binding generates a uniform benefit $B > 0$ to the groom, and induces disutility $C > 0$ to the bride. Further, we assume $B \leq C$ to reflect its painful process and that it is socially costly[23].

Equilibrium. In our model, an equilibrium specifies a matching of the whole population and foot-binding choices of every woman, where three conditions are satisfied: (1) feasibility: all candidates in the marriage pool are paired; (2) optimal foot-binding: no bride will be better off in expected marital payoffs by altering her foot-binding choice; and (3) no blocking pairs: no one in a pair has any incentive to find a better partner who also prefers the new pair. We only consider pure strategy equilibrium, because foot-binding is a childhood commitment and cannot be altered upon marriage. Formally, we have the following definition and assumptions:

Definition. An equilibrium in the game is a matching $M := \{(i,j)\}_{i\in I, j\in J}$ and a set of foot-binding choices $\{\mathbb{I}_{FB,i}\}_{i\in I}$ such that:

1. $\forall i \in I,\ \exists j \in J\ s.t.\ (i,j) \in M$; Symmetrically, $\forall j' \in J,\ \exists i' \in I\ s.t.\ (i',j') \in M$.

2. Given $\{\mathbb{I}_{FB,k}\}_{k\neq i}$, $\forall i \in I,\ \mathbb{E}_{j\in J}\left[V_B\left(q_i, q_j, \mathbb{I}_{FB,i}\right)\right] \geq \mathbb{E}_{j'\in J}\left[V_B\left(q_i, q_{j'}, 1-\mathbb{I}_{FB,i}\right)\right]$.

3. Given $\{\mathbb{I}_{FB,i}\}_{i\in I}$, there does not exist $(i,j),(i',j') \in M$, such that $V_B\left(q_{i'}, q_j, \mathbb{I}_{FB,i'}\right) \geq V_B\left(q_{i'}, q_{j'}, \mathbb{I}_{FB,i'}\right)$, $V_G\left(q_{i'}, q_j, \mathbb{I}_{FB,i'}\right) \geq V_G\left(q_i, q_j, \mathbb{I}_{FB,i}\right)$

To make the analysis more tractable, we make the following assumptions on the matching value function v and foot-binding disutility C:

Assumption 1. (Reservation utility). *Getting married always dominates staying single. The marriage benefits to brides and grooms are both larger than their reservation utilities, $V_B > \underline{V_B}$ and $V_G > \underline{V_G}$, where $\underline{V_B} > 0$ and $\underline{V_G} > 0$.*

[22]As an alternative way to model foot-binding decisions, we may introduce incomplete information and take it as a costly signal to reveal women's unobserved virtues. However, the key incentives remain equivalent that bridal families use costly actions to compete for better marriages. In this sense, our analysis stands as a benchmark model which highlights the interaction between men's mobility and marriage market competition instead of incomplete information.

[23]The process of foot-binding was not economically costly and no medical specialists were needed. It was mothers and grandmothers bound the feet of their daughters and granddaughters.

Assumption 2. (Complementarity). *v is continuous, convex and differentiable. In particular, $v_1, v_2, v_{11}, v_{22}, v_{12}, v_{21} > 0$. That is, v is increasing in both arguments. And v exhibits complementarity, so that for $q_1 \neq q_2$, $v(q_1, q_1) + v(q_2, q_2) > v(q_1, q_2) + v(q_2, q_1)$. Viewing men and women symmetrically, we have $v(q_1, q_2) = v(q_2, q_1)$.*

Assumption 3. (Marrying up is beneficial). *For any $\beta \in \{\beta_0, \beta_1\}$, linear combinations of h and l are greater than women's quality, $xh + (1-x)l > l + \beta l$, $\forall x \in (\underline{x}, 1]$, where $\underline{x} < \frac{1}{2}$.*

That is, the gap between h and l is sufficiently large that a lower class woman's value is always dominated by the gain of marrying into an upper class groom's family. With these assumptions, we analyze the dynamics of foot-binding in different institutional environments as follows.

3.1 Marriage Market with Inherited Status

We start with the baseline case of inherited status, where the relative importance of ability α equals zero and the only determinant of quality in the marriage market is family status. This case corresponds to the Wei-Jin, Southern and Northern Dynasties (220-589), when hereditary dominated and there existed rare social mobility[24]. Proposition 1 characterizes the equilibrium in this case, with matching pattern illustrated by Figure 2(a).

Proposition 1. *In a segregated society with inherited status, there exists an equilibrium where matching is positive assortative in family socioeconomic status and there is no foot-binding.*

Proof. See Appendix 8.4.

With inherited status, the quality of both brides and grooms within each class is homogeneous. The matching pattern is endogamy, with upper class brides matched with upper class grooms, and lower class brides matched with lower class grooms. This matching is stable since no one has an incentive to deviate or stay single. Moreover, there is no incentives for brides to make costly premarital investments, because the complementarity of the marriage output function guarantees that the benefit of marrying up is always less than the loss of marrying down, which means a lower class brides cannot compensate an

[24]During this era, the elite recruitment system was mainly the Nine Ranks-Rectifier System (Miyazaki,1977), in which men were ranked by local rectifiers (*Zhongzheng*, in Chinese) for promotion towards officials, mainly based on their family status and moral conduct.

upper class groom enough to marry her. The proposition reflects the marriage market matching equilibrium during this period, wherein powerful clans enjoyed hereditary privilege and were interconnected through marriages (Zhang, 2003). Thus, marriages were highly assortative in terms of family status, and there was no costly beauty investment (foot-binding) by the bridal families.

3.2 Restricted Examination System

This section examines the marriage market consequences of a gender-asymmetric shock in social mobility: the Civil Examination System. Specifically, we model the introduction of the system as a shock to the quality distribution of grooms. Unlike in the pre-exam era, where the groom's value was fully determined by his family's socioeconomic status, during the post-exam era, a groom's quality compoisition became more heterogeneous because of a positive return to men's ability. Along the two dimensions (family status and ability), we label grooms in four categories as shown in Figure 2(b): (i) *the champions* – the upper class grooms with high ability; (ii) *the fallen elites* – the upper class grooms with low ability; (iii) *the new elites* – the lower class grooms with high ability, and (iv) *the new lower class* – the lower class grooms with low ability. In addition to this changing distribution of grooms, the exams also introduced a higher risk of downward mobility, as natal family's status was no longer life-time secured. Therefore, the premarital investment by women was not only driven by marrying up opportunities, but also by mitigating the risk of downward mobility. Fitting into historical contexts, we consider two cases when the exam system has low meritocracy (i.e., the pre-Song period) and high meritocracy (i.e., the post-Song period). This section characterizes the pre-Song period, when the size of recruitment via exams was limited and the degree of meritocracy of the exams was low. We summarize the equilibrium for this scenario in Proposition 2.

Proposition 2. (Restricted Meritocracy). *When meritocracy plays a minor role, i.e. there exists a cutoff value $\alpha_1 < \frac{1}{2}$, no one practice foot-binding in either class when $\alpha \leq \alpha_1$. The matching equilibrium is positive assortative in family status.*

Proof. See Appendix 8.4.

Proposition 2 reveals the case when family status is a dominant factor in men's quality, and the benefit of marrying up is too small for women of both classes compared to the disutility of foot-binding. The proof consists of two parts, where the first part describes the nature of the competition and the second part solves for the cut-off value of α. First, due to

complementarity between the groom's and the bride's quality, there will be no cross-class marriage, thus the only competition is within-class. Second, since α determines men's quality gap within class, a larger α results in higher marrying up gain within class. Given a certain value of α, complementarity also implies a larger marrying up gain for upper class women than that for lower class women, so that the former always have a greater incentive to compete for better marriages. Therefore, given the fixed cost of foot-binding C, there exists a cut-off value α_1, so that at this point upper class women are indifferent to do foot-binding, where α_1 balances the expected marrying up benefits and the disutility cost, formally $(1-p)[v(h,h) - v(h,(1-\alpha_1)h + \alpha_1 l)] = C$. This is consistent with the history that, during the the pre-Song period where the exams were restricted, there was no foot-binding among either class of women.

3.3 Meritocratic Examination System

In this section, we discuss the exam system with a greater level of meritocracy – the Post-Song period. As shown in Section 2.2, the Song (960-1127) introduced major changes to the exam system, *i.e.* the scope of recruitment and procedural fairness, and was further institutionalized during the Ming (1368-1644) and the Qing (1644-1911). These changes resulted in a larger α in our model. In addition, since increasing α would naturally flip the ranking of men when $\alpha \geq \frac{1}{2}$, this section first considers the equilibrium without flipped ranking. To facilitate such an analysis without changing the key economic forces of our model, we introduce an additional assumption:

Assumption 4. (Bounded Disutility). *Foot-binding disutility has an upper bound, defined by* $\overline{C} = (1-p)[v(l, \frac{h+l}{2})) - v(l + \beta_0 l, l)]$, *so that women from both classes will take up foot-binding when* $\alpha \leq \frac{1}{2}$.

Assumption 4 bounds the disutility of foot-binding, as as to ensure both upper and lower class women will take up foot-binding when there is no flipped ranking[25]. With this setup, we summarize the equilibrium for this scenario in Proposition 3.

Proposition 3. (Prevalence of Foot-binding). *Foot-binding is first adopted by upper class women and later by lower class women. In particular, there exists a cutoff* α_2, *where* $\alpha_1 < \alpha_2 \leq \frac{1}{2}$, *that upper class women start foot-binding when* $\alpha > \alpha_1$, *and lower class*

[25]Without this assumption (e.g. when $C > \overline{C}$), we will see in Appendix 8.4 that lower class women will never take up foot-binding, which does not fit the historical facts.

women follow, after $\alpha > \alpha_2$. Denote the proportion of foot-binding women of upper class and lower class as r_w, r_u, respectively, then $0 < r_w \leq r_u \leq 1$ when $\alpha \in [\alpha_2, \frac{1}{2}]$

Proof. See Appendix 8.4.

Proposition 3 shows that foot-binding was first adopted by the upper class when the meritocratic recruitment is significant ($\alpha > \alpha_1$). Since complementarity implies the marrying up gain for lower class women is always less than that for upper class women, lower class women take up foot-binding at a higher cut-off value α_2. In particular, α_2 is the value at which the expected marrying up benefits for lower class women equals the disutility of foot-binding. With $\alpha_1 < \alpha_2$, the upper class women practice foot-binding earlier than the lower class.

For any α in $(\alpha_2, \frac{1}{2}]$, foot-binding was used by women of both classes, and the proportion of foot-binding in the upper class is higher than that of the lower class. Two elements contribute to this result: (i) the complementarity of brides and grooms, so that lower class women always have fewer marrying-up benefits than upper class women given a fixed α; and (ii) there exists a labor opportunity cost of foot-binding for lower class women, which is not the case for upper class women. In particular, because foot-binding impedes heavy labor and only lower class women play a laborious role in household production, lower class women additionally account for its opportunity cost in labor. In equilibrium, the proportions of women foot-binding in the upper and lower classes are pinned down by the net expected benefit of marrying up by foot-binding equaling the disutility of foot-binding. Historically, Proposition 3 captures the situation in the post-Song dynasties, when foot-binding first appeared among upper class women then spread to lower class women[26].

Comparative Statics. Based upon the above proposition, we present comparative statics in the following corollary:

Corollary 1. *The foot-binding percentage of upper class women r_u and lower class women r_w is non-decreasing with the proportion of high-ability men p, and non-increasing with the disutility of foot-binding C, when $\alpha \in [\alpha_1, \frac{1}{2}]$ for upper class and $\alpha \in [\alpha_2, \frac{1}{2}]$ for lower*

[26]The result in Proposition 3 characterizes an asymmetric equilibrium in a symmetric game with many players, in the sense that if we swap players, their payoffs are not affected.. This equilibrium can be thought of as the approximate outcome of the play of a specific symmetric mixed-strategy equilibrium, when each woman chooses foot-binding with a probability close to the fraction of foot-binding women within her class in this asymmetric pure-strategy equilibrium. With large numbers, the ex-ante probability and ex-post frequency are approximately the same (Cabral 1988).

class. For lower class women, the foot-binding proportion r_w is non-increasing with β_0 when $\alpha_2 \leq \alpha \leq \frac{1}{2}$.

Corollary 1 illustrates that foot-binding increases alongside a higher exam recruitment rate (p), which predicts a higher expected gain in the marriage market. It should be noted, a larger p can also predicts less competition in the marriage market, so that the relationship between p and foot-binding proportions is non-linear. However, since the actual recruitment rate of the exam is very low (Section 2.2), our discussion here is not expanded to the scenario with large values of p.

Given Section 4 provides empirical analysis testing this comparative statics using cross-sectional variation in p during the Qing dynasty, here we examine this prediction with archaeological findings of shoes for bound feet during the Song – the emerging stage of foot-binding. As documented, bureaucrat's wives and daughters had practiced foot-binding during the Song (Ebrey 1990). In particular, three pairs of shoes for bound feet during Song belonging to upper class women were found. We overlay the locations of the owner's birth place with the density of officials via examinations in Figure 4(a), where all three pairs of shoes were in regions with a high density of officials via examinations. As a robustness check, we also map the regional distribution of commercial tax during the Northern Song (Song, 1809) in Figure 4(b), which was more intensive in the North China Plain and the Yangtze River Delta, being divergent from the location of shoes. Further investigation of owner's life history in Appendix 8.6 shows that, among the three cases, two achieved marrying up to imperial family clans and bureaucratic families respectively, and one married to a young official at a similar bureaucratic level to her father's.

For foot-binding among lower class women, the intuition of Corollary 1 is straightforward – foot-binding is more intense where non-sedentary labor (β_0) is more valuable, yet the comparative statics in terms of the value of sedentary labor (β_1) is more complex. With greater value of sedentary labor (β_1), women face lower opportunity cost of foot-binding, but they also have lower marrying up benefits since now their own labor value is higher. So the direction of the effect of β_1 on r_w depends on whether the marrying up benefits or the disutility C dominates. In Section 4, we empirically test the comparative statics using archival data that captures regional variation in β_0 and β_1, looking into different agricultural regimes.

3.4 The Decline of Foot-binding

Following the logic of the above model, we characterize the decline of foot-binding as the consequence of two forces: (1) the decreasing benefit of foot-binding in the marriage market, driven by equalization in gender-specific mobility; and (2) the increasing opportunity cost of foot-binding in the labor market.

Regarding the first force, the exam system was abolished officially in 1905. During the Republican and following periods, girls had increasing educational, economic and social/public opportunities. The increasing equality of opportunities promoted gender-symmetric mobility, and women's quality dispersion began to catch up with that of men. In the model, this process can be characterized as α^G and α^B becoming more equal over time. Another economic force driving women out of foot-binding was the modern industrialization process in textile. Combining data on local transportation, industrialization and economic development, Bossen and Gates (2017) demonstrated that the demise of foot-binding was closely related to the rise of textile industries that gradually replaced traditional household handicraft production, and some of them had to leave home to work in distant factories. Under these circumstances, foot-binding is no longer a desired tool to compete in the marriage market, as its benefits shrank while its opportunity cost increased.

3.5 Summary, Extensions, and Discussion

3.5.1 Summary

To summarize the above theoretical results, we present Figure 3A showing how foot-binding prevalence changes with the degree of meritocracy (α) , based upon Propositions 1, 2, 3, and 7 (in Appendix 8.4).

When α is less than α_1, there's no incentive for foot-binding since the benefit fails to cover the fixed cost. When α reaches a cutoff (α_1), upper class women start foot-binding, and the proportion of foot-binding women among the upper-class jumps to a certain level. When α reaches a cutoff ($\alpha_2 \leq \frac{1}{2}$), lower class women start to take up foot-binding, and the proportion of foot-binding of upper class women is higher than that of lower class women. When $\alpha > \frac{1}{2}$ and there is flip in the ranking of new elites and fallen elites, women from both classes practice foot-binding, but with the two differences: (1) there is a discontinuity in the proportion of foot-binding upper class women, since now the average

quality of men that upper class women are competing for decreases; and (2) there exists a kink in the proportion of foot-binding among lower class women, since now marrying the fallen elites is less attractive for lower class women than before.

One may also wonder what proportion of women practice foot-binding as a function of disutility C, given a fixed value of α. In Figure 3B, we plot the proportion of foot-binding women in both upper and lower classes as a function of C, given $\alpha \in [\alpha_2, \frac{1}{2}]$ when both classes adopt foot-binding. Several points emerge from this figure. First, when the disutility of foot-binding C is below the expected marrying up benefits net of opportunity cost for lower class women, all women of both classes practice foot-binding since the cost is low and is fully offset by the benefits. Second, when C increases, fewer women take up foot-binding as the disutility of foot-binding increases. Lastly, when C becomes too large and dominants any marriage benefits, neither class will practice foot-binding[27].

3.5.2 Extensions

In addition to the baseline model, we provide three extensions as shown in Appendix 8.3. First, we assume a finer hierarchy of exam results instead of a binary structure, where individual intellectual capability can take three values, i.e. $\gamma \in \{High,\ Medium,\ Low\}$. This extension captures the fact that the actual talent structure of grooms was hierarchical (considering the number of trials and ranking in the exam), which predicts a larger impact of the exams on marriage market competition.

In the second extension, we allow the choice of foot-binding to be continuous rather than binary, so as to capture the fact that the size of feet can vary. With continuous foot-binding, brides differentiate themselves more precisely in the marriage market, whereas signal jamming takes place among upper class brides in the baseline model with binary foot-binding. This extension thus predicts variation in foot-binding size, which accounts for our forth stylized fact – the higher the social status was the bride, the smaller their feet were.

Finally, we introduce multiple price tools for premarital investment: dowry and foot-binding. In particular, we examine the interaction of these two competition tools and how this can change the strategy of bridal families in equilibrium. The third extension carries several new insights. First, as foot-binding investment requires a fixed cost, it will

[27]Considering Assumption 4 that imposes an upper bound of C, we have a further restriction that $C \leq \bar{C} = (1-p)[v(l, \frac{h+l}{2}) - v(l+\beta_0 l, l)]$, so that C will sit in the interval of $[p\Delta V_l - \delta, \Delta V_l]$ when α is approaching $\frac{1}{2}$, thus the proportion of foot-binding women of upper class will be in the interval of $(p, 1]$.

be adopted later than dowry payments. Second, when both tools play a role in marriage competition, both foot-binding intensity and dowry payments will increase with the degree of competition. Third, being qualitatively consistent with our previous results, upper class women still have greater foot-binding intensity and larger dowries compared to lower class women. The theoretical predictions by the last extension echo with historical facts, that an increasing degree of marriage market competition and dowry escalation took place during the post-Song period (e.g. Guo, 2000). To sum up, given the extensions enrich our predictions, the baseline model remains robust in capturing the major dynamics of foot-binding.

3.5.3 Discussion

To evaluate our assumptions and their validity, here we revisit our theoretical results by modifying two assumptions in the marriage market. Specifically, we first introduce unbalanced sex ratio and then account for polygyny instead of one-to-one matching.

Sex Ratio. Female infanticide was frequently observed in historical China, thus the actual sex ratio could be far from balanced. To illustrate, we set the sex ratio of men to women to be λ, where$\lambda > 1$, for both upper and lower class. For the pre-exam period under inherited status, the grooms were on the long side and men competed for a smaller pool of women (e.g. by bride prices). However, after the introduction of the exam, talented men switched to the short side of the market, as exam degree holders were still scarce[28]. This again, triggers competition among women, and the logic of our baseline model remains robust. The additional insight from a skewed sex ratio is that, a more imbalanced sex ratio (increasing λ) softens the competition among women, making foot-binding less prevalent, because the outside option is now better.

Polygyny. Under polygyny, richer men can marry multiple wives. In our theory, polygyny can be introduced by assuming that one upper class men can effectively marry η women, where $\eta > 1$ indicates the degree of polgyny. With the exam system introduced, the men's composition still became more heterogeneous, where upper women compete for the scarce talented upper class men (i.e. $\eta p < \mu$). Compared to our baseline model without polygyny, the opportunity to marry up expands from p to ηp for women, which increases the expected payoff from foot-binding. Therefore, the introduction of polygyny amplifies the effect of the exam.

[28]In the baseline model, we assume the exam passing rate is p under a balanced ratio for simplicity. In reality, the quota of exam passers in different regions seldom vary with local population changes.

Guided by theoretical predictions discussed above, we next use Republican archives to test the marriage and labor incentives of foot-binding empirically.

4 Archival Evidence

4.1 Data

To examine our theory empirically, this section analyzes cross-sectional county data on foot-binding from the Republican archives. Guided by Corollary 1, we focus on two determinants of foot-binding: the benefits of marrying up and the opportunity cost of female labor.

Foot-binding. Data on foot-binding prevalence come from a survey conducted by the Republican government in the early 1930s. Since 1928, the Republican government initiated nationwide campaign against foot-binding, using a survey to document the preexisting prevalence of foot-binding before the campaign (Yang, 2003). In particular, the Ministry of the Interior was responsible for the survey, which reports were kept in the Second Historical Archives of China (SHAC). The existing archives in SHAC cover part of the counties in four provinces – Shandong, Chahaer, Hunan and Yunnan. As illustrated by Figure 5 and 6, the four provinces have significant variation in agricultural, geographical, and socioeconomic conditions.

The main question of interest in the survey is the following: "*Before the implementation of the anti-foot-binding campaign, to what extent did women practice foot-binding?*" We code counties that clearly described intensive foot-binding practice as high prevalence, taking a value of one, and code those that describe foot-binding as being rare or nonexistent as low prevalence, taking a value of zero. Based upon the archives, the regional distribution of foot-binding prevalence is shown in Figure 5 (a). As a cross-validation, the distribution of foot-binding prevalence documented by the archives is very similar to that described in the styled facts in Section 2.

Consider the nature of the sample, there exist two concerns in selection: first, counties could be selected into the archives; second, within the archival sample, counties with and without information on foot-binding could be different in a systematic way. For our analysis, selection is only an issue if it is driven by unobserved characteristics correlated with determinants of foot-binding. We use three strategies to cope with this concern: (1) we conduct balance check between out-of-archive and in-archive counties; as shown

in Appendix Table A5, the two groups do not display systematic difference in terms of agricultural suitability or county exam quota across provinces; (2) we practice balance check between ambiguous/missing information counties and clear-information counties; as shown by Appendix Table A6, none of the variables show significant differences in mean across the two groups of counties; (3) in the main empirical analysis, we account for a rich set of variables in demographic, geographic, and socioeconomic conditions at prefecture or county level, as well as province fixed effects. Further, with an instrumental variable strategy, we exploit the exogenous variation in county exam quota to identify the determinants of foot-binding.

Women's Labor. We first test the comparative statics regarding foot-binding and women's labor value, by exploiting agricultural regimes that drive both non-sedentary (farming) and sedentary (household handicraft) labor values. For non-sedentary labor, the two major cereal crops – rice and wheat – differed in both gender-specific comparative advantage and labor-input intensiveness. Given that wheat is more suitable for heavy plough usage where men have comparative advantage, women have a comparative advantage in rice cultivation, especially in transplanting rice seedlings. Further, rice requires twice as much as labor input than wheat[29]. Thus in rice regions, women's labor is in greater demand and they frequently worked alongside their husbands in the rice paddies.

Empirically, we explore the county level variation in crop suitability, captured by suitability indexes developed by FAO's GAEZ (Global Agro-Ecological Zones)[30]. The indexes are compound indicators for potential crop yields that capture exogenous and predetermined geographical and ecological factors. Mapping to our theory, a greater suitability of rice captures higher β_0, while a greater suitability of wheat captures lower β_0. We use the relative suitability of rice to wheat as a proxy of high-value non-sedentary agricultural activity, where a higher relative suitability of rice predicts larger β_0. For women's sedentary labor value, we use cotton suitability which captures the access to sources of this fiber to proxy the sedentary labor value β_1, given cotton was a dominant high-value handicraft fiber[31] (Xue, 2017).

[29] Appendix Table A4 presents number of days of man-labor required per crop hectare for major crops (Buck,1937). The average number of labor days required for crops in the wheat regime was around 100, while the average number of labor days required in the rice region was almost double. In a double cropping system of rice, early and late rice were counted as a whole.

[30] The suitability index of a certain crop is estimated based on a model, which has been applied considering the average climate of baseline period 1961-1990 reflecting suitability levels and distributions within grid cells. All suitability indexes are taken under the condition of rain-fed intermediate input level. Figure 6 illustrates the regional distribution of suitability index of rice, wheat, and cotton.

[31] Another dimension for suitability in household handicraft is spinning-weaving technology, determined

Women's Marrying-up Prospects. Next, we test the comparative statics regarding women's marrying-up benefits – captured by the proportion of elite through the exams (p). To exploit regional variation in p, we investigate an institutional feature of the exam – the quota system. As shown in Section 2.2, the exam quotas served as a tool to regulate elite recruitment and social mobility across regions, allocated at different levels of the exam. Specifically, we examine quota assignment at county level for the recruitment of the *Literati*, for two reasons: (1) the *Literati* degree were obtained mostly during marriageable ages (16-25), and it was a necessity to obtain upper level degrees; and (2) marriage market was mostly local where county is a more precise than prefecture/province. To understand quota allocation, we examine four sets of determinants discussed by scholars (Chang, 1955, Shang, 2004, Liang and Zhang, 2013, Bai and Jia, 2016, Chen, Kung, and Ma, 2017) – (1) population, (2) tax obligations, (3) historical talent distribution, and (4) political concerns and social stability – and construct exogenous variation driving quota allocation at county level in the next session.

4.2 Empirical Strategy

Empirical Setup. Our empirical analysis employs a sample of 148 counties in four provinces with clearly foot-binding prevalence information. Table 2 presents descriptive statistics of key variables, and Appendix Table A9 shows a correlation table for main variables. In particular, we use the following regression specification:

$$Footbinding_{ip} = \alpha + \beta Suitability_{ip} + \gamma Exam\ Quota_{ip} + \boldsymbol{X_{ip}}\mu + \theta_p + \epsilon_{ip}$$

Here foot-binding prevalence in county i, province p is a dummy variable, taking one for high prevalence, and zero for low prevalence. Our key explanatory variables include the relative suitability of rice to wheat, the suitability for cotton, and county exam quota. $\boldsymbol{X_{ip}}$ is a vector of control variables, including prefecture population in 1820, land tax per capita in 1820, number of Ming Presented Scholars, distance to Ming garrisons, number of chaste women of the Qing, Mongolian migration history, distance to courier routes, and distance to provincial capital. θ_p include province fixed effects, and ϵ_{ip} is error term. The explanatory variables are standardized to facilitate comparing the magnitudes, and robust standard errors are used clustering at province level.

by relative humidity, as established by Xue (2017).

Identification Strategy. With the above specification, the suitability indexes capture exogenous and predetermined geographical and ecological factors, which identify the opportunity cost of foot-binding driven by different agricultural regimes. However, the identification of the effect of exam quotas on foot-binding – as a proxy of women's marrying-up prospects – calls for exogenous variation, since the allocation of quota had deep economic and political rational which may affect foot-binding decisions at the same time.

To this purpose, we first revisit the four sets of determinants discussed above, which revealed the decision rule of the state. Given quota allocation was adjusted based on the size of population and local economy, the nature of the exam system in regulating both social mobility and bureaucratic recruitment resulted in a trade-off faced by the state: on the one hand, to maintain a competent pool of bureaucrats, the state had incentive to recruit more from regions at the top of the historical talent distribution (*the Competence concern*); on the other hand, to maintain social stability with a certain level of guaranteed social mobility, the state was also incentivized to promise greater social mobility to regions that are under higher risk of rebellion or conflicts (*the Stability concern*)[32]. Our instrument is constructed combining the *Competence* and *Stability* concerns, using the interaction term between historical talent distribution and historical political risk, where the former is measured by the number of Ming Presented Scholars (Wu, 2009), and the latter is captured by the distance to the Ming garrisons (military-economic units for military purposes), both at county level.

Next, we discuss how this instrument satisfies the exogeneity and exclusion restriction. First, as our instrument is constructed with an implicit Diff-in-Diffs strategy, the underlying assumption is the difference in unobserved socioeconomic characteristics between counties at the top and bottom at the historical talent distribution stays the same for being less and more distant from garrisons. This assumption can reasonably survive given the fact that garrisons were located for military purposes. Therefore, our instrument enables us to exploit the differential increment in quota allocation by comparing counties along the historical talent distribution and political stability dimensions. Second, for exclusion restriction, one may concern that this interaction term may capture the differential effects driven by geographic or transportation characteristics, therefore affect foot-binding not only through quota assignment. To resolve this concern, we directly control for the interactions between historical talent and geographic/transportation characteristics in our

[32]In particular, by investigating the impact of abolition of the exam system on social uprisings at different locality, Bai and Jia (2016) uses the variation in prefecture level exam quotas and finds that a higher density of quota were associated with a higher probability of revolution participation after the abolition of the system.

full specification.

4.3 Results and Robustness

Table 3 shows OLS results, where provincial fixed effects are controlled throughout and standard errors are clustered at province level. Column 1 only includes suitability variables and county exam quotas, and Column 2 accounts for the four determinants of county exam quotas. Conditional on the set of determinants, an one standard deviation's increase in quota leads to 2.7 percentage point's higher incidence in foot-binding prevalence. Compared to this effect, an one standard deviation's increase in the relative suitability of rice (cotton) leads to 8.3 (15.8) percentage points lower (higher) probability in foot-binding prevalence respectively, while the determinants of quota are not statistically significantly different from zero.

In Column 3, we further control for geographic and transportation characteristics, including distance to courier routes, distance to provincial capital, and the interaction terms between these two and Ming Presented Scholars, to as to capture the interactive effect between transportation conditions and historical talent distribution. In Column 4, we account for a potential confounder of the exam quota – the strength of Confucianism, as it may both correlate with exam quotas and foot-binding due to its embedded moral codes on women's virtue[33]. Specifically, we control the number of chaste women at prefecture level during the Qing dynasty to capture local Confucianism (Kung and Ma, 2014). Finally, Column 5 tests an alternative hypothesis on foot-binding related to ethnic identity concerns by Han Chinese women, that they could have used foot-binding to distinguish themselves from other ethnic groups. In particular, we control for historical Mongolian migration intensity after the 13^{th} century (Wu and Cao, 1997). By progressively controlling for observables in Column 2-5 , we find the effects of relative suitability of rice, cotton, and exam quotas stayed stable.

Given Table 3 is informative, concerns still exist regarding the unobserved characteristics that may drive both quota allocation and foot-binding. In Table 4, we employ the instrument variable strategy discussed above. Panel A, B, and C present results on the second stage, first stage, and reduced form respectively. Column 1-4 adopt progressive sets of

[33]But Neo-Confucianism itself did not propose foot-binding, that none of its classics had advocated foot-binding. Cheng, Yi (1033-1107), one of the leading philosophers of Neo-Confucianism in the Song, was against foot-binding practice and his female family members till the Yuan dynasty(1271-1368) did not conduct foot-binding. In Section 5, we empirically test the impact of Confucianism on foot-binding prevalence.

controls, where Column 1 includes the full set of determinants of county exam quotas, Column 2 adds the geographic and transportation characteristics, Column 3 accounts for Confucianism and Column 4 controls for Mongolian migration history. The estimated effects of agricultural suitability and exam quota are stable across columns. Specifically, in Column 4, an one standard deviation's increase in quota leads to 16.8 percentage point's higher incidence in foot-binding prevalence, while an one-SD increase in the relative suitability of rice and cotton leads to 7.3 percentage points lower and 17.8 percentage points higher probability in foot-binding prevalence respectively. For the first stage results in Panel B, the interaction term between historical talent distribution and historical political risk predicts more quota significantly, and the *F-statistics* are above 10 in Column 2-4. Finally, the reduced form results presented in Panel C show that our instrument predicts higher probability in foot-binding prevalence, where the estimated magnitudes are stable across columns. To sum up, the empirical examination based on the archives is consistent with our model predictions.

5 Concluding Remarks

Economic incentives can deeply influence cultural practices. We explain the economic motives of foot-binding in historical China by considering both marriage market and labor incentives: (1) foot-binding can improve marriage market outcomes for women by making themselves more attractive; and (2) foot-binding carries significant disutility and can induce labor cost depending on the type of women's labor. Our empirical analysis using county-level from the Republican archives shows that higher suitability of rice relative to wheat and higher suitability for household handicraft affected foot-binding among lower class women, and the county exam quota predicts a higher incidence of foot-binding prevalence. Together, we show that the prevalence of foot-binding among lower class women increases with the marriage market prospects and decreases with the labor opportunity cost of foot-binding.

Overall, our paper sheds light upon cultural practices from an economic perspective, showing that an equal mobility institution without gender bias, as well as women's active participation in economic activities can be protective against cultural customs that carry high disutility for women. Future work may expand the insights to other gender-biased social norms, and further derive policy implications in eradication of existing harmful gender norms (Auriol et al. 2018).

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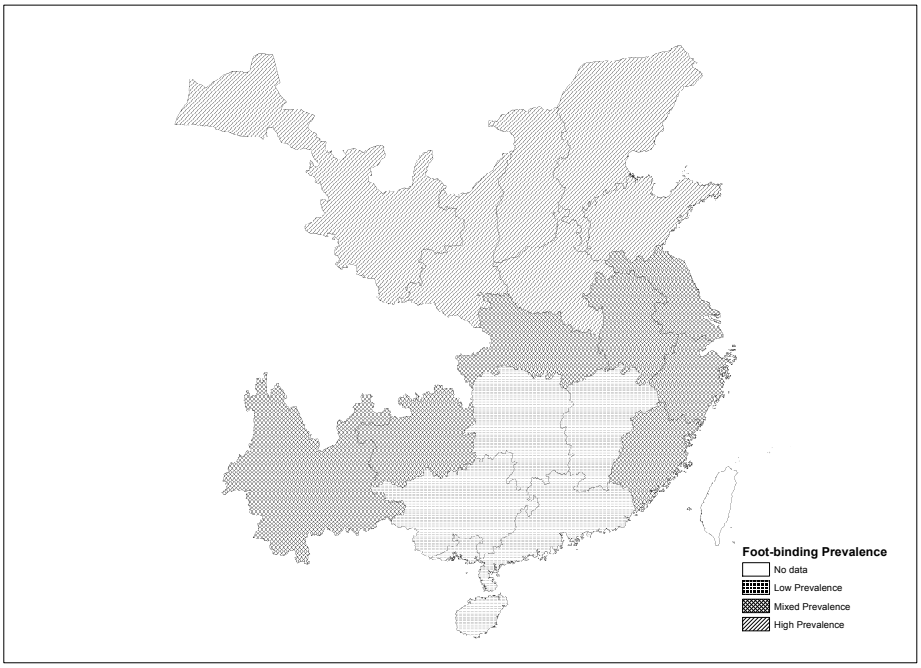
Please refer to Appendix 8.8 for references in history and anthropology.

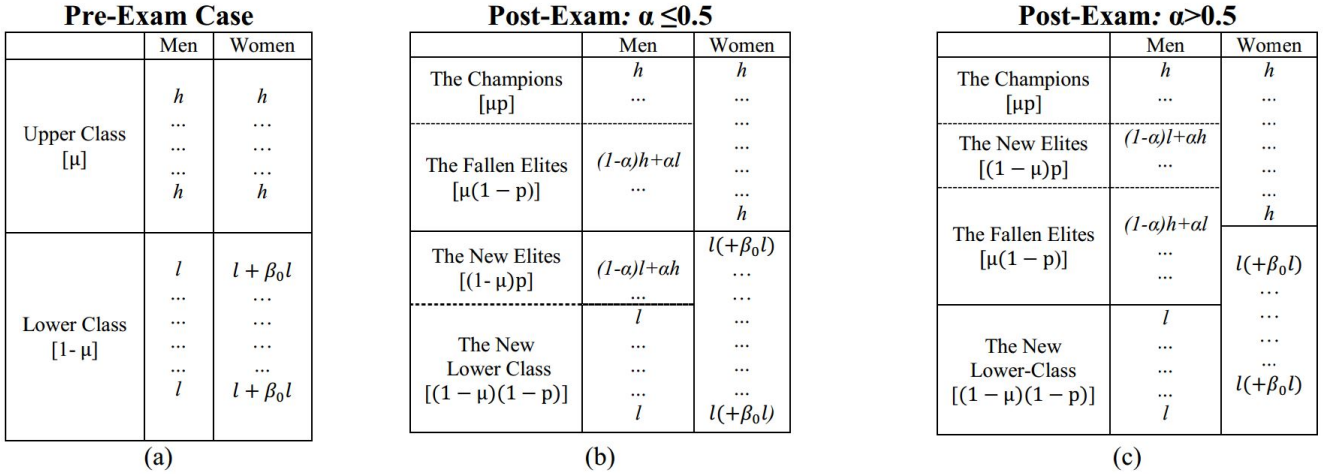
7 Figures and Tables

Figure 1: Regional Variation of Foot-binding Prevalence



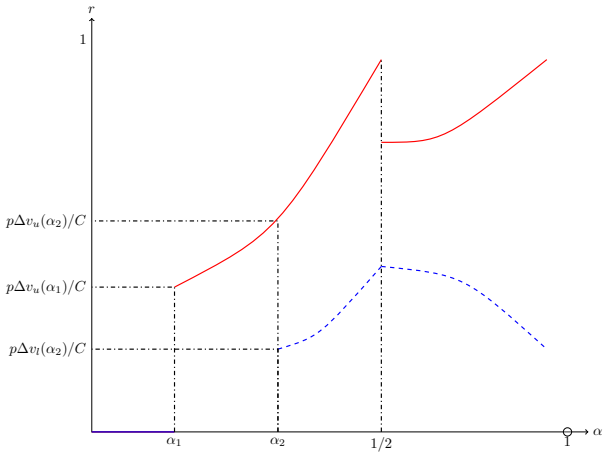
Note: The foot-binding prevalence variable on province level is based on historical qualitative evidence, including Hu (1936); Qian (1969); Xu (1984); Ko (2005); Davin (1976); Lu (1987); Yao (1936); Turner (1997).

Figure 2. Matching Illustration



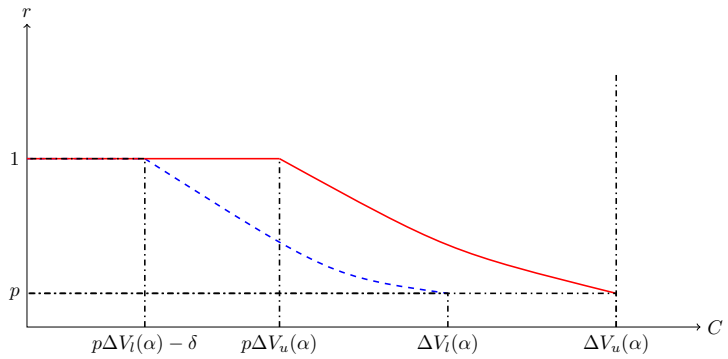
Note: We use brackets for lower class women's quality since their quality depends on their husbands' wealth status. In the case of marrying a wealthy enough husband (with quality measure higher than h), the wife do not have to work in the household. Panel (a) is corresponding to Proposition 1 (the pre-Exam case), Panel (b) refers to Proposition 2 (Restricted Meritocracy) and 3 (Prevalence of Foot-binding), and Panel (c) characterizes Proposition 7 (Flipping Ranking).

Figure 3A. Foot-binding Prevalence and Exam Meritocracy α



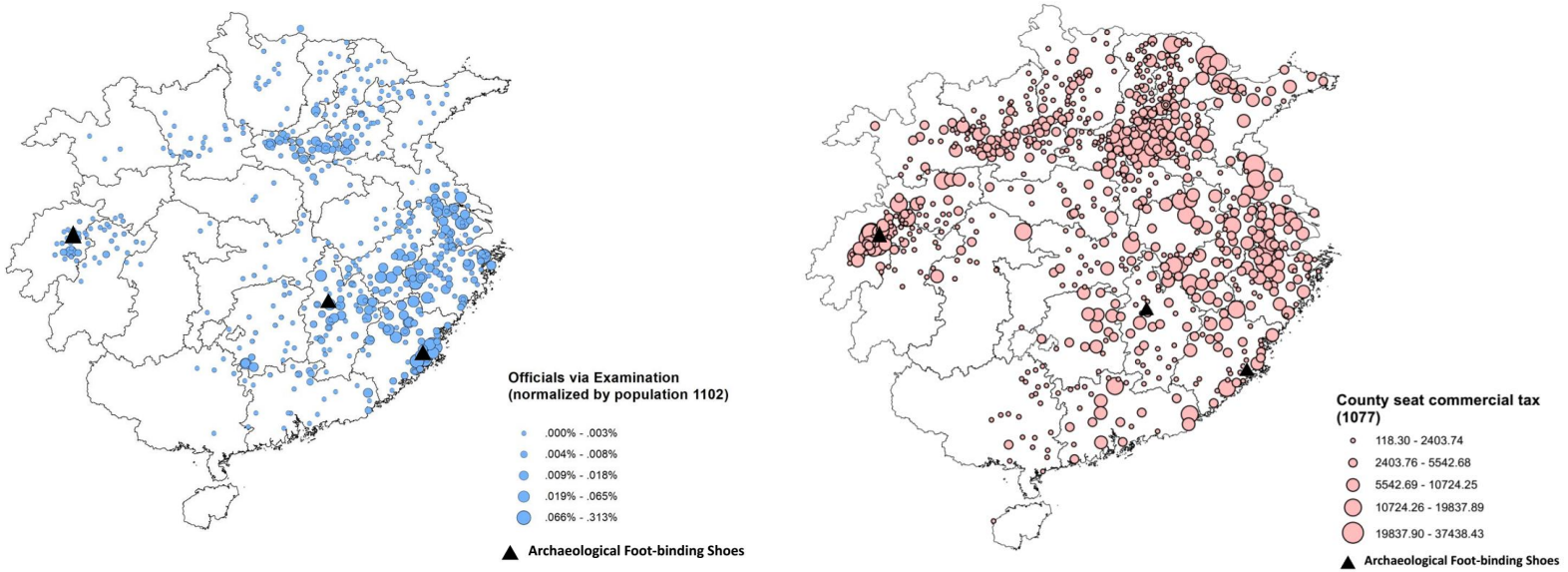
Note: This figure is drawn based on Proposition 1, 2, 3 and 7 (in appendix). The horizontal axis is α, or the relative weight of talent for men determined by the mobility institutions (i.e. the exam system). The vertical axis is the proportion of foot-binding within class. Here $\Delta V_u = v(h,h) - v(h,(1-\alpha)h+\alpha l)$, and $\Delta V_l = v(l,(1-\alpha)l+\alpha h) - v(l+\beta_0 l, l)$. Proposition 1 characterizes the case when $\alpha = 0$, Proposition 2 refers to the case when $\alpha \in (0, \alpha_1]$, Proposition 3 captures the case when $\alpha \in (\alpha_1, \frac{1}{2}]$ for upper class women and $\alpha \in (\alpha_2, \frac{1}{2}]$ for lower class women, and Proposition 7 describes the case when $\alpha \in (\frac{1}{2}, 1)$. Here the solid line in red denotes upper class women, while the dashed line in blue denotes lower class women.

Figure 3B. Foot-binding Prevalence and Disutility



Note: This figure of foot-binding prevalence is drawn given the α discussed in Proposition 3. The red solid line denotes upper class women, while the blue dashed line denotes lower class women. Here $\Delta V_u(\alpha) = v(h,h) - v(h,(1-\alpha)h+\alpha l)$, which is the marrying up gain for upper class women. The marrying up gain for lower class women is $\Delta V_l(\alpha) = v(l,(1-\alpha)h+\alpha l) - v(l+\beta_0 l, l)$. The labor opportunity cost of foot-binding δ is $[v(l+\beta 0 l, l) - v(l+\beta 1 l, l)]$.

Figure 4. Locations of Archaeological Lotus Shoes

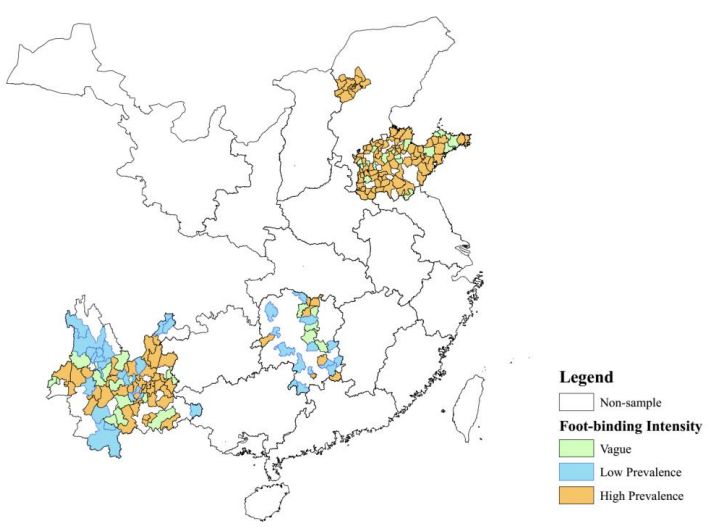


(A) Shoes and Officials via Examination

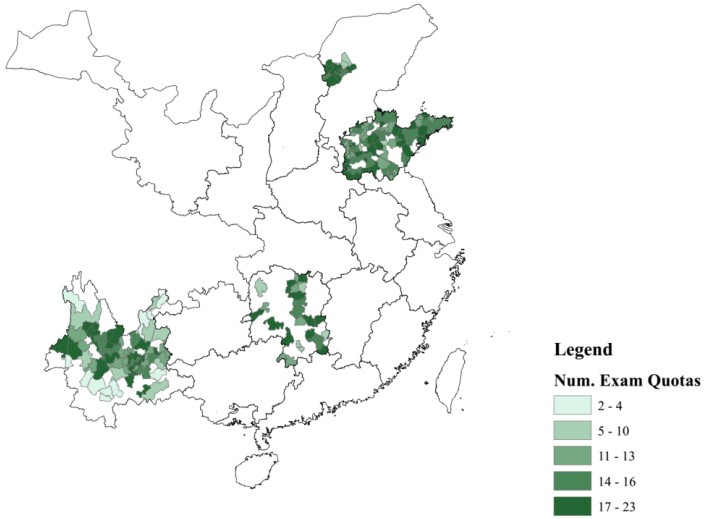
(B) Shoes and Commercial Tax

Note: Black triangles denote the birth place of owners of the three pairs of foot-binding shoes, as recorded by Ebrey (1992). Appendix 5 provides a brief life history of the three female owners in archaeology findings. Panel A illustrates the distribution of number of officials via examinations in Northern Song, normalized by Song population (Bielenstein, 1987). Panel B displays the regional distribution of commercial tax (Song, 1809).

Figure 5: Sample Counties: Foot-binding and Exam Quotas



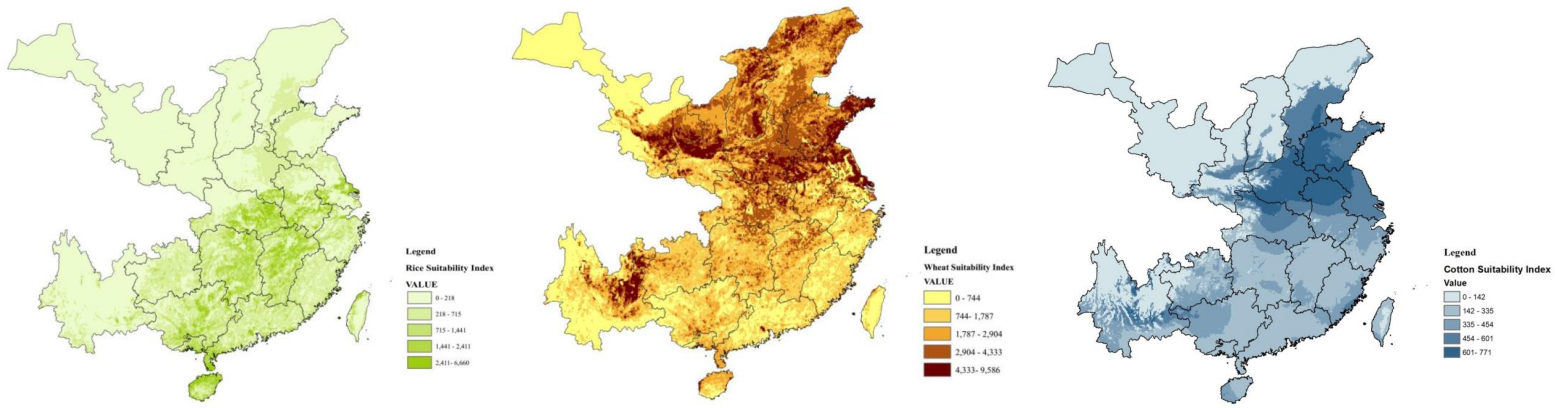
(A) Archival Counties: Prevalence of Foot-binding



(B) Archival Counties: Number of Exam Quotas

Note: Sample counties are from the Republican archives on foot-binding in the Second Historical Archives of China. Four provinces are covered by the archives: Shandong, Chahaer, Hunan and Yunnan. Panel A shows rural foot-binding prevalence, and Panel B illustrates distribution of county exam quotas (Kun et al. 1899).

Figure 6: Regional Distribution of Agricultural Suitability



(A) Rice Suitability Index (B) Wheat Suitability Index (C) Cotton Suitability Index

Note: The data in this map comes from geographic distribution of crop suitability from the FAOs GAEZ (Global Agro-Ecological Zones). The suitability index of a certain crop is estimated based on a model, which has been applied considering the average climate of baseline period 1961-1990 reflecting suitability levels and distributions within grid cells. All suitability indexes are taken under the condition of rain-fed intermediate input level. Panel A shows the suitability index for rice, Panel B shows that for wheat, and Panel C is for cotton. The base map is from CHGIS v4.

Table 2: Descriptive Statistics

Variables	**Mean**	**Std.Dev.**	**Min**	**Max**	**Sources**
Foot-binding prevalence	0.797	0.403	0	1	A
Relative suitability (standardized)	-0.359	1.531	-4.599	4.802	B
Cotton suitability (standardized)	-0.176	1.181	-1.944	1.362	B
County exam quota	14.764	4.815	2	23	C
Prefecture population 1820 (persons)	1872590	1282566	125828	4453658	D
Prefecture land tax p.c. 1820	0.071	0.048	0.001	0.175	E
Number of presented scholars (Ming)	9.973	12.135	0	59	F
Number of chaste women	204.291	143.850	4	625	G
Mogolian migration history intensity	0.636	0.760	0	2	H
Distance to courier routes (km)	112.309	102.400	0.260	488.269	I,J
Distance to provincial capital (km)	170.672	99.714	13.696	479.543	I
Distance to Ming garrisons (km)	55.832	36.392	0.946	256.09	I,K

Sources: A. The Ministry of the Interior Archives, Republic of China; B. FAO GAEZ Crop Suitability (1965-1990); C. Kun et al. (1899), Imperially Established Institutes and Laws of the Great Qing Dynasty (Daqing Huidian Shili); D. Cao (2001); E. Liang (1981); F. Wu (2009); G. Jiaqing Revision of a Unified Geography (Jiaqing Chongxiu Yitongzhi, 1843); H. Wu and Cao (1997); I. CHGIS version 4; J. G. W. Skinner, Zumou Yue, Mark Henderson, 2008, "ChinaW–Cities, County Seats and Yamen Units (1820 - 1893)"; K. Harvard ChinaXmap: Ming Garrisons (1363-1644).

Table 3: Crop Suitability, Exam Quotas and Foot-binding Prevalence

	Dependent Var: Foot-binding Prevalence				
	(1)	(2)	(3)	(4)	(5)
Relative Suitability (rice-wheat)	-0.090**	-0.083**	−0.068†	−0.069†	−0.069†
	(0.028)	(0.018)	(0.033)	(0.033)	(0.033)
Cotton Suitability	0.176**	0.158**	0.134*	0.136**	0.137**
	(0.042)	(0.037)	(0.048)	(0.042)	(0.042)
County Exam Quota	0.039†	0.027**	0.027**	0.026*	0.026*
	(0.017)	(0.005)	(0.006)	(0.009)	(0.009)
Pref. Population 1820		-0.079	-0.083	-0.093	-0.094
		(0.070)	(0.082)	(0.091)	(0.090)
Land Tax pc. 1820		0.058	-0.000	-0.001	0.000
		(0.032)	(0.039)	(0.041)	(0.042)
Ming Presented Scholar		-0.012	-0.108	-0.105	-0.106
		(0.016)	(0.099)	(0.088)	(0.088)
Dist. to Ming Garrison		-0.058	-0.053	-0.053	-0.054
		(0.044)	(0.042)	(0.042)	(0.042)
Transportation	No	No	Yes	Yes	Yes
Chaste women	No	No	No	Yes	Yes
Mongolian Migration	No	No	No	No	Yes
Prov. FE	Yes	Yes	Yes	Yes	Yes
Observations	148	148	148	148	148
R-squared	0.377	0.405	0.413	0.413	0.414

Note: *** p<0.01, ** p<0.05, * p<0.1, † p<0.15. Parentheses include standard errors clustered by province. Dependent variable is a dummy variable indicating high prevalence of foot-binding, and key explainatory variables include relative suitability index (rice to wheat) and county exam quota, where both are standardized. The set of control variables includes prefecture population, land tax per capita at 1820, number of Presented Scholars during Ming, and distance to Ming garrisons. All explainatory variables are standardized.

Table 4: Crop Suitability, Exam Quotas and Foot-binding: IV Results

	Panel A. Second Stage: Foot-binding Prevalence			
	(1)	(2)	(3)	(4)
County Exam Quota	0.159***	0.162***	0.162***	0.168***
	(0.053)	(0.043)	(0.041)	(0.042)
Relative Suitability (rice-wheat)	-0.082***	-0.074***	-0.074***	-0.073***
	(0.016)	(0.025)	(0.024)	(0.024)
Cotton Suitability	0.187***	0.184***	0.178***	0.178***
	(0.033)	(0.051)	(0.047)	(0.049)
Observations	148	148	148	148
R-squared	0.328	0.338	0.339	0.332
	Panel B. First Stage: County Exam Quota			
	(1)	(2)	(3)	(4)
Ming Presented Scholars x Dist. Garrisons	0.280*	0.273**	0.271**	0.265**
	(0.113)	(0.051)	(0.063)	(0.067)
F-statistics	6.09	28.32	18.36	15.74
R-squared	0.397	0.432	0.449	0.450
	Panel C. Reduced Form			
	(1)	(2)	(3)	(4)
Ming Presented Scholars x Dist. Garrisons	0.044**	0.044†	0.044†	0.045†
	(0.012)	(0.021)	(0.021)	(0.022)
R-squared	0.412	0.419	0.420	0.420
Control variables				
Determinants of Quota	Yes	Yes	Yes	Yes
Prov. FE	Yes	Yes	Yes	Yes
Transportation	No	Yes	Yes	Yes
Chaste women	No	No	Yes	Yes
Mongolian Migration	No	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses, clustered by prefecture. Dependent variable is a dummy variable indicating high prevalence of foot-binding within county. All explainatory variables are standardized.

8 Online Appendix

8.1 Foot-binding in Historical Accounts

As we have discussed above, foot-binding was an unpresentable and cryptic topic to discuss in public domain, and even taboo in official genres. Therefore, there is a lack of systematic record of foot-binding by the imperial government during the Song, Ming and Qing. In this section, we will summarize and compare different sources recorded and compiled by a variety of authorship on foot-binding, trying to piece out the picture of foot-binding and cross-check the evidence one from another.

Overall, sources on foot-binding have significant variation, ranging from semi-official records, privately compiled history, personal history, literature, and folklore, to archaeological evidence. Appendix Table A1 provides a summary, presenting the types and contents, authorship/compilers, time range, accessibility and potential bias. It could be clearly seen that those sources are very different by nature, thus relying merely on one type of the sources may result in bias in understanding foot-binding. As listed as 1 in Appendix Table A1, the first type of sources on foot-binding we examine is official records by the Republican government. In the early 20th century, the Republican government prohibited foot-binding and surveyed to investigate the process of prohibition from 1931 to 1934 (Yang, 2003).In this process, the local county government conducted survey on previous foot-binding prevalence and the progress of anti-footbinding campaign, then sent reports to the Republican government, which were later compiled by the Ministry of The Interior. This is the primary source used by this paper for empirical analysis.

The second type of the sources on foot-binding is from gazetteers (on province, prefecture, and county level), which is semi-official compared with governmental records. The authors of gazetteers are mostly local gentries, scholars, and officials, and the compiling were largely based on local files, records, and personal observations. Foot-binding in gazetteers was barely mentioned from the Song to mid-Qing dynasty, and mostly mentioned during the late Qing and Republican Years. For gazetteers published during the late Qing, most of the text on foot-binding appears in the chapter of "local customs". During the Republican years, the gazetteers almost uniformly mentioned foot-binding as a bad custom along with description on anti-footbinding campaigns. Taken together, only around 230 localities (mostly counties) have foot-binding texts in gazetteers, and most of the content is anti-foot-binding, not about the pre-existing culture of foot-binding. Therefore, while

gazetteers could be a good source for supplementary purpose, they will be most useful for understanding the anti-footbinding process.

The third type of our sources on foot-binding are jottings (in Chinese, Biji), literature and privately compiled history. The authors of such type are mostly scholars, historians, philologists, and sometimes even amateurs of foot-binding, e.g., Qian, Yong(1759-1844), Xu, Ke(1869-1928), Hu, Pu-an (1878-1947), Yao, Ling-hsi(1899-1963). Their accounts cover the widest aspect of foot-binding history, and are irreplaceable in the value of first-hand observation on foot-binding. Their accounts of foot-binding are often a key source for contemporary scholars, including Dorothy Ko(2005) and Susan Mann(1997).

The fourth type of the sources is anthropology, personal history, and interviews (e.g. see a rich source summarized by Turner, 1997, and Gates, 2015; Bossen and Gates, 2017 for contemporary interviews with foot-binding women). The authors of this type of sources include foreign visitors/scholars, Christian missionaries, travelers, and foot-binding women themselves. The key merit of this type of source is its first-hand observation and experiences. For instance, Bossen and Gates (2017) show their interviews with 1800 rural senior women in 27 villages (9 provinces), consulting their foot-binding history (if any), personal life history, economic activities, village characteristics, and so on. This source is again irreplaceable in helping us to understand foot-binding on the grassroots.

The fifth source we look at is the folkloristic evidence and oral literature, i.e., ballads (e.g. see Zhang, 2015). The authors of the ballads are the folk. Compiled by domestic or foreign observers, the folk ballads described foot-binding in various ways, often bringing remarkable insight into this phenomenon. However, the drawback of this source is also clear--we do not know its time span and what kind of ballads survived and why. Thus the folk ballads will be taken as complementary sources when we examine our theory and empirical predictions.

The final source we discuss in this paper is the archaeological evidence (bound feet shoes/lotus shoes) (see Ebrey 1992 for example). The clear advantage of this source is that it is the only source that can help us to date back to the early dynasties (e.g., the Song, 960-1279). By examining the owner of the shoes, her family status, as well as the location of shoes, this type of source will be important for us to understand foot-binding at its earlier phase.

8.2 Flipped Rankings under High Meritocracy

Historically, the magnitude of α during the Post-Song period should be less than half for two reasons. First, at the timing of marriage market matching, potential grooms are mostly taking the entry level exams at the county level, the degree of which only guarantees a lowest level of gentry class, especially compared to the higher degrees obtained at older ages (e.g. *Recommended Men* or *Presented Scholars*). Therefore, a degree of Literati can hardly dominate the importance of family background at this stage, so that most marriage market matching are still taking place within social class, though the competition within class getting intensified (Chen, 1936). Second, the *de facto* probability of being successful in higher rankings of the exams was different among the upper and lower class men. In a landmark study of this literature, Ho (1962) demonstrates the patterns of social mobility associated with the exam system in the Ming and the Qing, showing that the proportion of degree holders from commoner's family background was below 50% for most of the time during the two dynasties[34]. Recent quantitative findings are largely in line with Ho's perspective (e.g. Kung and Jiang, 2015, Shiue, 2017), that the exam system increased social mobility but with noticeable heterogeneity by social status, that the higher status families had advantages over lower status families in succeeding in exams.

Section 3 of our paper has analyzed cases when $\alpha < \frac{1}{2}$. To get a full picture of foot-binding dynamics with high α, we further examine the case when $\alpha > \frac{1}{2}$ so that the ranking of groom's quality is flipped. Using the group labels in Figure 4(b), now the marriage market ranking from the highest to lowest is: *the champions, the new elites, the fallen elites*, and *the new lower class*. An illustration of the equilibrium matching for this case can be found in Figure 4(c). Proposition 7 characterizes the foot-binding practice when the exam system is highly meritocratic and the society has high mobility.

Proposition 4. *When men's competence dominates family status* ($\frac{1}{2} < \alpha < 1$)*, foot-binding is adopted by women of both classes, and is more prevalent in the upper class. The proportion of foot-binding women in the upper class is* $r_u = min\{\frac{p}{C}\{\mu[v(h,h) - v(h,(1-\alpha)h+\alpha l)] + (1-\mu)[v(h,(1-\alpha)l+\alpha h) - v(h,(1-\alpha)h+\alpha l)]\},\ 1\}$ *and in the lower class is* $r_w = min\{\frac{p[v(l,(1-\alpha)h+\alpha l)-v(l+\beta_1 l,l)]}{C+v(l+\beta_0 l,l)-v(l+\beta_1 l,l)},\ 1\}$*. Further,* $0 < r_w \leq r_u \leq 1$*.*

In this case, upper class brides compete for two types of men – the champions and new elites. The remaining upper class brides then compete with lower class brides for the fallen

[34]This finding applies to both Presented Scholars (*Jinshi*) and Recommended men (*Juren*) (see Ho, 1962, Table 9 and 11).

elites. In equilibrium, the expected net payoff from foot-binding in the marriage market is equal to the disutility of foot-binding, which condition pins down the proportion of foot-binding women in the upper and lower classes. With similar logic to that of Proposition 3, the proportion of upper class women who bind their feet is greater than that of lower class women. It should be noted that, when the upper class women compete for two types of men with only one tool for competition (the binary foot-binding option), the marriage benefits between marrying champions or new elites cannot be further absorbed by the competition. In the extensions of our model in Section 5, we will discuss foot-binding as a continuous competition tool, and also consider the availability of multiple competition tools (i.e. dowry payments) for further investigation.

Corollary 2. *The foot-binding percentage of upper class women and of lower class women is non-decreasing in the proportion of high ability men p, and non-increasing with the disutility of foot-binding C when* $\frac{1}{2} < \alpha < 1$. *For lower class women, the foot-binding percentage is non-increasing in* β_0.

Corollary 2 establishes comparative static predictions for the case of $\frac{1}{2} < \alpha < 1$. It delivers similar predictions to Corollary 1. Thus, the key comparative statics are robust whether α is larger than one half or not.

8.3 Extensions

8.3.1 Hierarchical Structure of the Exam System

Previously, we assume a binary exam structure, i.e. $\gamma \in \{h, l\}$, corresponding to high and low ability captured by the exams. Here, we replace the binary structure with multi-level achievement structure, i.e. $\gamma \in \{H,\ M,\ L\}$, representing three levels of ability that reflecting high, medium and low rankings in the Exam. To capture a pyramid structure of talents, we assume the probability of getting a high score H is p (the same as before), that of getting a medium score M is q, and $0 < p < q < 1 - p - q$. Further, we focus on the case when $\alpha < \frac{1}{2}$ to fix the ranking of grooms and present the analysis comparable to Section 3.3. With the new assumptions, the quality distribution of grooms are described in the Table 1, with labels A-F provided for each group of grooms:

>>Table 1: Groom's Quality Distribution with Hierarchical Ranking<<

Quality Ranking	l	$(1-\alpha)l+\alpha m$	$(1-\alpha)l+\alpha h$	$(1-\alpha)h+\alpha l$	$(1-\alpha)h+\alpha m$	h
Category	F	E	D	C	B	A
Male Population	$(1-\mu)(1-p-q)$	$(1-\mu)q$	$(1-\mu)p$	$\mu(1-p-q)$	μq	μp

Proposition 5. *With hierarchical exam rankings, the quality of grooms is further spread. Women of both classes will practice foot-binding, and it is more intensive among upper class. Moreover, the prevalence of foot-binding is higher than the benchmark case for women of both classes.*

Proof. See Appendix 9.3.

When $\alpha < \frac{1}{2}$, upper class women seek for marriages of grooms with ranking A and B within class, and lower class women seek for those with ranking D and E within class. Similar to Proposition 3, here the no-cross-class marriage is a result of the complementarity between brides and grooms. Comparing the prevalence of Proposition 4 and Proposition 3, we also have that a higher proportion of foot-binding women in both classes in this extension, which is directly driven by the additional marrying up benefits of the M-type talent men within class. Given that the *de facto* talent measures of grooms could be a richer set (considering the number of their trials in taking the exam, their ranking in the exam), the impact of the exams on marriage market is actually much larger than the impact calculated purely based on the number of degree holders, therefore our quantification in Section 3.3 provides a lower bound on the marriage market effects of the exams.

8.3.2 Continuous Choice of Foot-binding

In this section we analyze adoption of foot-binding when the choice is continuous instead of binary. As before, we assume that foot-binding is costly and there are only two ability levels revealed by the exam (H and L). The key difference is we allow the disutility of foot-binding to be a continuous function of binding intensity, $c(b)$, with the following assumption:

Assumption 5. (Cost of Continuous Foot-binding) (1). $c(b) = 0$ for $b \in [0, \underline{b})$, $0 < c(b) < c\left(\overline{b}\right)$ for $b \in \left[\underline{b}, \overline{b}\right]$, and $c(b) = c\left(\overline{b}\right)$ for $b \in (\overline{b}, \infty)$; (2). $c^{'} > 0$, $c^{''} < 0$ for $b \in \left[\underline{b}, \overline{b}\right]$.

The first property says that a small degree of foot-binding, i.e. $b \in [0, \underline{b})$, is not costly until it deforms the feet. The practice of foot-binding is physically subject to a point when it is physically impossible to further bind the feet, i.e. $b = \overline{b}$. The second property says

that the cost of foot-binding increases in binding intensity and is concave. To simplify our analysis here, we assume the benefits of foot-binding $B(b) = c(b)$. Following similar logic, now the counterpart we have of Assumption 4 (bounded disutility) is the following:

Assumption 6. (Bounded Disutility with Continuous Foot-binding). *The cost of foot-binding is positive but bounded from above, i.e.* $0 < c(\overline{b}) \leq \overline{C}_{cont}$*, so that lower class women take up foot-binding when* $\alpha \leq \frac{1}{2}$*. In particular,* $\overline{C}_{cont}$ *is defined by* $\overline{C}_{cont} = v(l, \frac{h+l}{2}) - v(l + \beta_0 l, l)$.

The return to lower class women's labor value with continuous foot-binding now is defined by the following:

$$\beta = \begin{cases} \beta_0 & if \quad b < \underline{b} \\ \beta_1 & if \quad b \geq \underline{b} \end{cases}$$

Therefore, following a logic similar to that in Section 3.1 and 3.2, we define following proposition for the case of continuous foot-binding:

Proposition 6. (Continuous Foot-binding). *When foot-binding is continuous:*

(1) There's no foot-binding in upper class below cutoff $\tilde{\alpha_1}$*, and no foot-binding in lower class below cutoff* $\tilde{\alpha_2}$*, where* $\tilde{\alpha_1} < \tilde{\alpha_2}$.

(2) When $\alpha \in [\tilde{\alpha_1}, \frac{1}{2}]$*, a population of* μp *upper class women take up foot-binding with binding intensity* b_u*; when* $\alpha \in [\tilde{\alpha_2}, \frac{1}{2}]$*,* $(1-\mu)p$ *lower class women take up foot-binding with intensity* b_l*, where* $b_u > b_l$.

(3) When $\alpha \in (\frac{1}{2}, 1)$*, a population of* μp *upper class women choose binding intensity* b_C*,* $(1-\mu)\,p$ *choose binding intensity* b_{NE}*, and* $(\mu - p)$ *choose no foot-binding; for lower class women,* $p\,(1-\mu)$ *choose foot-binding with intensity* b_{FE}*. In particular,* $b_C > b_{NE}$ *and* $b_C > b_{FE}$.

Proof. See Appendix 9.3.

With continuous foot-binding, brides differentiate themselves more precisely in the marriage market. In the binary model, signal jamming takes place among upper class brides competing for champions and new elites. In the case of continuous foot-binding, upper class brides separate themselves by adopting a higher intensity of foot-binding to compete for champions, and a lower intensity to compete for the new elites. Since the population of champions and new elites combined is smaller than that of upper class brides (i.e.

$p < \mu$), Bertrand competition stops when foot-binding intensities completely absorb any marrying-up benefits. This result hinges on the assumption that foot-binding is able to provide large enough benefits to achieve separation, since otherwise brides can pool to maximal binding intensity, and we are back to the binary case. Therefore, the continuous foot-binding case predicts within-class variation in foot-binding intensity. Historically, this echoes with our last stylized fact, that the higher the social status was the bride, the smaller their feet were.

8.3.3 Multiple Competition Tools: Dowry and Foot-binding

In this section, we allow for dowry payments in addition to foot-binding to see if the existence of alternative means of competition in the marriage market alters our earlier results. To accommodate full generality, we assume continuous foot-binding. To highlight the interactions between dowry and foot-binding, we assume away the small labor value differences under different levels of foot-binding ($b \geq \underline{b}$), that is, $\beta = 0$. The marriage values for two sides with both dowry and foot-binding are as follows:

$$\text{Brides' Utility Function: } V_B\left(q_i, q_j, b_{FB,i}, d\right) = v\left(\theta_i, \alpha\gamma_j + (1-\alpha)\theta_j\right) - c\left(b_{FB,i}\right) - u\left(d_i\right)$$

$$\text{Grooms' Utility Function: } V_G\left(q_i, q_j, b_{FB,i}, d\right) = v\left(\theta_i, \alpha\gamma_j + (1-\alpha)\theta_j\right) + b\left(b_{FB,i}\right) + u\left(d_i\right)$$

Here we do not include the budget constraint of the bride's family to highlight the substitution between dowry and foot-binding when there are interior solutions. One can easily add in budget constraints, and the qualitative results of the analysis remain unchanged.

Now the bride's family needs to decide both foot-binding intensity $b_{FB,i}$ and the size of the dowry payment d_i. Since dowry is usually offered as a direct monetary transfer, we assume $u^{'} > 0$, $u^{''} < 0$ and $u^{'}(0) = 1$, that is, a monetary transfer has diminishing marginal returns. Furthermore, it is possible that $d_i < 0$ (negative dowry, or, bridal price) as bound feet can be extremely attractive that men are willing to pay for them. We focus on $d_i \geq 0$ in this paper but the same analysis goes through for $d_i < 0$ simply by assuming $u(-d) = -u(d)$, $d > 0$, in the aforementioned marriage values. The potential existence of negative dowry highlights the (overly) strong substitution between foot-binding and dowry. Adopting Assumption 5 and 6 in the continuous foot-binding, we have the following proposition:

Proposition 7. (Foot-binding and Dowry). *When both dowry and foot-binding are available, we have the following cases:*

(1) There's no foot-binding nor dowry payment in either class when $\alpha = 0$. *After a cutoff of* $\tilde{\alpha_1}$ *for upper class and* $\tilde{\alpha_2}$ *for lower class, bride's family use dowry* $d^*_{0,u}$ *and* $d^*_{0,l}$ *respectively, where* $\tilde{\alpha_1} < \tilde{\alpha_2}$*; for given* $\alpha \in [\tilde{\alpha_1}, \tilde{\alpha_2}]$, $d^*_{0,u} > d^*_{0,l}$.

(2) When $\alpha \in [\tilde{\alpha_1}, \frac{1}{2}]$, *a population of* μp *upper class women choose binding intensity* b^*_u *and dowry size* d^*_u*; when* $\alpha \in [\tilde{\alpha_2}, \frac{1}{2}]$, $(1-\mu)p$ *lower class women choose binding intensity* b^*_l *and dowry size* d^*_l*;*

(4) When $\alpha \in (\frac{1}{2}, 1)$, *a population of* μp *upper class women choose binding intensity* b^*_C, *dowry size* d^*_C*;* $p(1-\mu)$ *choose binding intensity* b^*_{NE}, *dowry size* d^*_{NE}*; and* $(\mu - p)$ *choose no foot-binding and pay no dowry. For lower class women,* $p(1-\mu)$ *choose binding intensity* b^*_{FE}, *dowry size* d^*_{FE}. *In particular,* $b^*_C > b^*_{NE}$, $b^*_C > b^*_{FE}$, $d^*_C > d^*_{NE}$, *and* $d^*_C > d^*_{FE}$.

Proof. See Appendix 9.3.

The above proposition carries several new insights. First, as foot-binding investment requires a fixed cost, it will be adopted later than dowry payments. In this sense, dowry payments are more flexible than foot-binding. Second, when both tools play a role in marriage competition, both foot-binding intensity and dowry payments will increase with the degree of competition. In fact, this is exactly what we have observed since the Song dynasty, that more and more historical accounts include parent's complains about high dowries required to marry their daughters for both class (e.g. Guo, 2000). Third, being qualitatively consistent with our previous results, upper class women still have greater foot-binding intensity and larger dowries compared to lower class women.

8.4 Proofs of Propositions and Corollaries

Proof of Proposition 1

Proof. In the pre-exam period, we start from the matching where upper class brides are matched with upper class grooms, lower class brides are matched with lower class groom, and there is no foot-binding. We check such matching is in equilibrium.

The only players who have incentive to seek for better marriage opportunities are the lower class brides, because the upper class brides are already paired with the best grooms

possible. If one of them chooses to foot-binding, then the condition that an upper class groom is willing to switch for her is:

$$v(l,h)+B>v(h,h)\Rightarrow B>v(h,h)-v(l,h)$$

That is, the foot-binding benefits outweigh the costs of marry-down. And the condition that the lower class bride is willing to choose foot-binding is:

$$v(l,h)-C>v(l+\beta_0 l,l)\Rightarrow C<v(l,h)-v(l+\beta_0 l,l)<v(l,h)-v(l,l)$$

However, since $B\leq C$, if the two conditions hold, we have $v(h,h)-v(l,h)<v(l,h)-v(l,l)$, which contradicts with v being complementary. Thus lower class bride has no incentive to choose foot-binding. The matching is in equilibrium.

However, there might be multiple equilibria in the game. To require the equilibrium to be unique, we need an additional assumptions on the value function that $v(x,x)\geq v(x+a,x-a)$ for all $0<a\leq x$.

Among all assortative matching outcome the non-foot-binding matching is obviously unique because without competition there is no need to bind feet. If there exists another non-assortative matching, then there exists at least a pair (h,l) and a pair (l,h). To start with, the lower class bride in (l,h) must have bound her feet, because otherwise the groom should choose an upper class bride.

If the h bride deviates to pair up with the h groom, then the payoff difference is $v(h,h)-v(h+\beta l,l)$. By Assumption 3, when $x=1$, $h-l>\beta l$, $v(h,h)-v(h+\beta l,l)\geq v(h+\beta l,h-\beta l)-v(h+\beta l,l)>v(h+\beta l,l)-v(h+\beta l,l)=0$ therefore $v(h,h)-v(h+\beta l,l)>0$, regardless of foot-binding choices. So the h bride has incentive to deviate.

Next we check whether the h groom prefers the h bride to the original l bride. There are two cases: (1) the h bride has bound feet. Then the h groom prefers the h bride immediately, and the original matching is not stable; (2) the h bride has natural feet. Then the h groom compares a non-foot-binding upper class bride and a foot-binding lower class bride: if the groom prefers the foot-binding lower class bride, it means $v(h,h)\leq v(l,h)+B$, in which case for the lower class bride $C\geq v(h,h)-v(l,h)>v(l,h)-v(l,l)$. Therefore the lower class bride prefers not to bind the feet and marry a lower class groom in the first place. Again, the original matching is not in equilibrium. Thus uniqueness is proven under the additional assumption.

Proof of Proposition 2

Proof. The proof is constructed as follows. First, we discuss any possible competition between or within class. Second, we determine the conditions of no foot-binding in upper class and lower class respectively. Lastly we compare the conditions to prove the proposition.

First, due to complementarity (Assumption 2), the lower class bride never seeks for cross-class marriage. Specifically, for a lower class bride matched with, for example, a champion through foot-binding, the marrying-up benefit of the bride's side should be able to compensate the marrying-down loss of the champion, i.e.: $v(l,h)-v(l+\beta_0 l,l) > v(h,h)-v(l,h)$. However, due to complementarity, this will not be feasible. Thus cross-class marriage is not feasible, and there only exists competition within class.

Second, we examine within class competition among women, that upper brides are matched with champions and fallen elites, lower class brides are matched with new elites and new lower class.

Lemma 1. *There exists α_1 such that no foot-binding is adopted in intra-class marriage in upper class when $\alpha < \alpha_1$.*

For the upper bride to stay in class without foot-binding, we require the cost of foot-binding is too large compared with the benefit of marrying up, that is, $v\left(h,h\right)-C \leq pv\left(h,h\right)+\left(1-p\right)v\left(h,(1-\alpha)h+\alpha l\right)$, then $C \geq \left(1-p\right)\left[v\left(h,h\right)-v\left(h,(1-\alpha)h+\alpha l\right)\right]$. Denote the cutoff value of α as α_1.

Lemma 2. *There exists α_2 such that no foot-binding is adopted in intra-class marriage in lower class when $\alpha_1 < \alpha_2 \leq \frac{1}{2}$.*

For the lower class bride to stay in class without foot-binding, we require when everyone else choose no foot-binding, a lower class bride has no incentive to do so either: $v\left(l,(1-\alpha)l+\alpha h\right)-C \leq pv\left(l,(1-\alpha)l+\alpha h\right)+\left(1-p\right)v\left(l+\beta_0 l,l\right)$, then $C \geq \left(1-p\right)\left[v\left(l,(1-\alpha)l+\alpha h\right)-\right.$ Denote the cutoff value as α_2.

Since v is convex, we have $v\left(h,h\right)-v\left(h,(1-\alpha)h+\alpha l\right) > v\left(l,(1-\alpha)l+\alpha h\right)-v\left(l,l\right) > v\left(l,(1-\alpha)l+\alpha h\right)-v\left(l+\beta_0 l,l\right)$, where the first equality is guaranteed by mean value theorem. Therefore $\alpha_1 < \alpha_2 < \frac{1}{2}$. Here $\alpha_2 < \frac{1}{2}$ is directly guaranteed by Assumption 4, where $C < \bar{C} = \left(1-p\right)\left[v\left(l,\frac{l+h}{2}\right)-v\left(l+\beta_0 l,l\right)\right]$. □

Proof of Proposition 3

Proof. Follow the proof of Proposition 2, we know that when $\alpha \leq \alpha_1$ there is no foot-binding in upper class, and when $\alpha_1 < \alpha \leq \alpha_2$, there is foot-binding in upper class but

not in the lower class. When $\alpha_2 \leq \alpha \leq \frac{1}{2}$ there are foot-binding in both class. Here it remains to show the foot-binding percentage in upper class and lower class, denoted as r_u and r_l respectively.

For upper class, when $\alpha \in [\alpha_1, \frac{1}{2}]$, in equilibrium the percentage of foot-binding women should make the marriage benefit with and without foot-binding indifferent, if the solution is interior. That is:

$$\tfrac{p}{r_u} v\left(h,h\right) + \left(1 - \tfrac{p}{r_u}\right) v\left(h,(1-\alpha)h + \alpha l\right) - C = v\left(h,(1-\alpha)h + \alpha l\right)$$

Thus $r_u = \frac{p}{C}\left[v\left(h,h\right) - v\left(h,(1-\alpha)h + \alpha l\right)\right]$. Of course there is a natural upper bound of r_u, where everyone binds their feet. So, $r_u = min\{\frac{p}{C}\left[v\left(h,h\right) - v\left(h,(1-\alpha)h + \alpha l\right)\right],\ 1\}$.

For lower class, when $\alpha \in [\alpha_2, \frac{1}{2}]$, in equilibrium the percentage of foot-binding women should make the marriage benefit with and without foot-binding indifferent. That is:

$$\tfrac{p}{r_l} v\left(l,(1-\alpha)l + \alpha h\right) + \left(1 - \tfrac{p}{r_l}\right) v\left(l + \beta_1 l, l\right) - C = v\left(l + \beta_0 l, l\right), \text{ thus}$$
$$r_l = \tfrac{p[v(l,(1-\alpha)l+\alpha h) - v(l+\beta_1 l,l)]}{C + v(l+\beta_0 l,l) - v(l+\beta_1 l,l)}.$$

Again, combining the boundary case, we have:

$$r_l = min\{\tfrac{p[v(l,(1-\alpha)l+\alpha h) - v(l+\beta_1 l,l)]}{C + v(l+\beta_0 l,l) - v(l+\beta_1 l,l)},\ 1\}$$

Lastly, by complementarity of v, we have foot-binding is less prevalent in the lower class, i.e. $r_l \leq r_u$.

Proof of Proposition 4:

Proof. The proof is constructed as follows. First, we examine the possibility of inter-class marriages when $\alpha < \frac{1}{2}$. With complementarity (Assumption 2), the lower class bride never seeks for cross-class marriage. In particular, a lower class bride cannot compensate the marrying-down loss of ranking A and B grooms through foot-binding. Thus cross-class marriage is not feasible, and there only exists competition within class.

Second, we examine within class competition among women, that upper brides are matched with ranking A and B grooms, lower class brides are matched with D and E grooms.

Lemma 3. *There exists $\alpha_1^{Ext.}$ such that no foot-binding is adopted among upper class women when $\alpha < \alpha_1^{Ext.}$.*

For the upper bride to stay in class without foot-binding, we require the cost of foot-binding is too large compared with the benefit of marrying up, that is, $v\left(h,h\right) - C \leq$

$pv\,(h,h)+qv(h,(1-\alpha)h+\alpha m)+(1-p-q)\,v\,(h,(1-\alpha)h+\alpha l)$, then $C \geq (1-p)\,[v\,(h,h)-v\,(h,(1-\alpha)h$ $q[v(h,(1-\alpha)h+\alpha m)-v(h,(1-\alpha)h+\alpha l)]$. Denote the cutoff value of α as $\alpha_1^{Ext.}$, thus $\alpha_1 < \alpha_1^{Ext.}$.

Lemma 4. *There exists $\alpha_2^{Ext.}$ such that no foot-binding is adopted among lower class women when $\alpha_1^{Ext.} < \alpha_2^{Ext.} \leq \frac{1}{2}$.*

For the lower class bride to stay in class without foot-binding, we require when everyone else choose no foot-binding, a lower class bride has no incentive to do so either:

$$v\,(l,(1-\alpha)l+\alpha h)-C \leq$$
$$pv\,(l,(1-\alpha)l+\alpha h)+qv\,(l,(1-\alpha)l+\alpha m)+(1-p-q)\,v\,(l+\beta_0 l,l),$$

then

$$C \geq (1-p)\,[v\,(l,(1-\alpha)l+\alpha h)-v\,(l+\beta_0 l,l)]-q[v\,(l,(1-\alpha)l+\alpha m)-v\,(l+\beta_0 l,l)].$$

Denote the cutoff value as $\alpha_2^{Ext.}$.

Since v is convex, $\alpha_1^{Ext.} < \alpha_2^{Ext.}$. Moreover, to make sure that lower class women adopt foot-binding when α is less than half for the multiple talent case, the upper bound of disutility is $C^{Ext.} = (1-p)\left[v\left(l,\frac{l+h}{2}\right)-v\,(l+\beta_0 l,l)\right]-q[v\left(l,\frac{l+m}{2}\right)-v(l+\beta_0 l,l)]$, which is smaller than $\bar{C}$ given in Assumption 4. Thus, we have $\alpha_1^{Ext.} < \alpha_2^{Ext.} < \frac{1}{2}$.

Upper class brides now compete on grooms with ranking A and B. The lower class brides compete on grooms with ranking D and E within class. Suppose equilibrium foot-binding percentages in both class are r_u^{Ext} and r_l^{Ext}, respectively, then apply the indifference condition and assume interior solution:

$\frac{p}{r_u}v\,(h,h)+\frac{q}{r_u}v\,(h,(1-\alpha)l+\alpha m)+\left(1-\frac{p+q}{r_u}\right)v\,(h,(1-\alpha)h+\alpha l)-C = v\,(h,(1-\alpha)h+\alpha l)$, so that the proportion of foot-binding women in upper class is:

$$r_u^{Ext} = \frac{p[v(h,h)-v(h,(1-\alpha)h+\alpha l)]+q[v(h,(1-\alpha)l+\alpha m)-v(h,(1-\alpha)h+\alpha l)]}{C}.$$

Add the boundary, we have:

$$r_u^{Ext} = min\{\frac{p[v(h,h)-v(h,(1-\alpha)h+\alpha l)]+q[v(h,(1-\alpha)l+\alpha m)-v(h,(1-\alpha)h+\alpha l)]}{C},\ 1\}.$$

For lower class women, in equilibrium the percentage of foot-binding women should make the marriage benefit with and without foot-binding indifferent. That is:

$\frac{p}{r_l}v\,(l,(1-\alpha)l+\alpha h)+\frac{q}{r_l}v\,(l,(1-\alpha)l+\alpha m)+\left(1-\frac{p+q}{r_l}\right)v\,(l+\beta_1 l,l)-C = v\,(l+\beta_0 l,l)$, so that $r_l = \frac{p[v(l,(1-\alpha)l+\alpha h)-v(l+\beta_1 l,l)]+q[v(l,(1-\alpha)l+\alpha m)-v(l+\beta_1 l,l)]}{C+v(l+\beta_0 l,l)-v(l+\beta_1 l,l)}$.

Add the boundary, we have:

$$r_l^{Ext} = min\{\tfrac{p[v(l,(1-\alpha)l+\alpha h)-v(l+\beta_1 l,l)]+q[v(l,(1-\alpha)l+\alpha m)-v(l+\beta_1 l,l)]}{C+v(l+\beta_0 l,l)-v(l+\beta_1 l,l)},\ 1\}.$$

By complementarity of v it is easy to check that $r_l^{Ext} \leq r_u^{Ext}$ in this case. Moreover, comparing the proportion of foot-binding women in either class in this case with our baseline model, it's easy to check: $r_u < r_u^{Ext}$ and $r_l < r_l^{Ext}$.

Proof of Proposition 5:

Proof. (1), (2) and (3): Following the logic of the proof of Proposition 1, when $\alpha = 0$ there exists no incentive to practice foot-binding. In addition, following our complementarity assumption, any inter-class marriage is not feasible, so that the competition is merely within-class.

As there exists a fixed-cost for foot-binding, namely $c(\underline{b})$, upper class women will only start foot-binding when $\alpha \in [\tilde{\alpha_1}, \frac{1}{2}]$, where $\tilde{\alpha_1}$ is defined by $c(\underline{b}) = v(h,h) - v(h,(1-\tilde{\alpha_1})h + \tilde{\alpha_1} l)$, when μ of upper class women take up foot-binding, and their foot-binding intensity choice b_u perfectly absorbs the marry-up benefit: $c(b_u) = v(h,h) - v(h,(1-\alpha)h + \alpha l)$. Similarly, when $\alpha \in [\tilde{\alpha_2}, \frac{1}{2}]$, where $\tilde{\alpha_2}$ is defined by $c(\underline{b}) = v(l,(1-\tilde{\alpha_2})l + \tilde{\alpha_2} h) - v(l+\beta_0 l, l)$, μ of lower class women take up foot-binding, and their foot-binding intensity choice b_l perfectly absorbs the marry-up benefit: $c(b_l) = v(l,(1-\alpha)l + \alpha h) - v(l+\beta_0 l, l)$.

(4) When $\alpha \in (\frac{1}{2}, 1)$, that we have a flipping ranking of new elites and fallen elites, the upper class women are now competing for both the champions and the new elites, while the lower class women is competing for fallen elites left. Now the Bertrand competition leads to the unique outcome where all rents from marrying up are dissipated. That is,

$$c(b_C) = v(h,h) - v(h,(1-\alpha)h + \alpha l)$$

$$c(b_{NE}) = v(h,(1-\alpha)l + \alpha h) - v(h,(1-\alpha)h + \alpha l)$$

It is immediate that both binding intensities increase with α. In this case, upper class brides are indifferent between $b = 0, b = b_C$ or $b = b_{NE}$. Therefore the share of brides who adopt the corresponding intensities should coincide with the share of champions and new elites. The same logic applies to lower class brides, where

$$c(b_{FE}) = v(l,(1-\alpha)h + \alpha l) - v(l+\beta_0 l, l)$$

The share of lower class bride's population who bind their feet should also coincide with the rest of the fallen elites, which has size $\mu + (1-\mu)\,p - \mu = (1-\mu)\,p$. Due to complementarity, we have $b_C > b_{NE}$, and $b_C > b_{FE}$. When α is slightly larger than $\frac{1}{2}$, $b_{FE} > b_{NE}$, and when α is close to 1, $b_{FE} < b_{NE}$. □

Proof of Proposition 6.

Proof. (1) Similar logic of the proof of Proposition 1.

(2) As the foot-binding investment calls for a fix amount of cost $c(\underline{b})$, it will not be used until the marry-up benefits within class can compensate the minimum level of cost. Following similar analysis of Proposition 6, upper class women start foot-binding when $\alpha \in [\tilde{\alpha_1}, \frac{1}{2}]$, where $\tilde{\alpha_1}$ is defined by $c\,(\underline{b}) = v(h,h) - v(h,(1-\tilde{\alpha_1})h + \tilde{\alpha_1} l)$, and lower class women take up foot-binding when $\alpha \in [\tilde{\alpha_2}, \frac{1}{2}]$, where $\tilde{\alpha_2}$ is defined by $c\,(\underline{b}) = v(l,(1-\tilde{\alpha_2})l + \tilde{\alpha_2} h) - v(l+\beta_0 l, l)$.

For upper class, when $\alpha \in (0, \tilde{\alpha_1})$, bride's family only uses dowry payments. The dowry payments will perfectly absorb the marrying up benefit, so now the dowry by the upper class brides is defined by: $u(d^*_{0,u}) = v(h,h) - v(h,(1-\alpha)h + \alpha l)$. Similarly, when $\alpha \in (0, \tilde{\alpha_2})$, the lower class brides' family only use dowry payments. The dowry payment level in lower class is defined by $u(d^*_{0,l}) = v(l,(1-\alpha)l + \alpha h) - v(l+\beta_0 l, l)$. By complementarity of v it is easy to check that $d^*_{0,u} > d^*_{0,l}$ given a certain level of $\alpha \in (0, \tilde{\alpha_1})$.

(3): When $\alpha \in [\tilde{\alpha_1}, \frac{1}{2}]$, both foot-binding and dowry payments will be used by upper class women; and when $\alpha \in [\tilde{\alpha_2}, \frac{1}{2}]$, both price tools will be used by lower class women. We can construct proof in following steps:

Step 1. We solve the continuous "package benefit" choice problem where

$$\text{Bride: } V_B\,(q_i, q_j, h_i) = v\,(\theta_i,\ \alpha\gamma_i + (1-\alpha)\theta_i) - h_i$$

$$\text{Groom: } V_G\,(q_i, q_j, h_i) = v\,(\theta_i,\ \alpha\gamma_j + (1-\alpha)\theta_j) + h_i$$

where bride's family chooses an effective marriage package benefit h_i. Denote the solution of the above problem h_i^* .

Step 2. We solve the substitution problem between foot-binding and dowry choice.

$$\min_{b_i, d_i} c\,(b_i) + u\,(d_i)$$

$$s.t.\ c\left(b_i\right)+u\left(d_i\right)\geq h_i^*$$

Solving Step 1 is exactly the same as in Section 3.5.2. So it only remains to show how the optimal b_i and d_i is solved. Given h_i^*, this minimization problem is solved when the following two equations hold:

$$c^{'}\left(b_i\right)=u^{'}\left(d_i\right)$$

$$c\left(b_i\right)+u\left(d_i\right)=h_i^*$$

With both $c\left(\cdot\right)$ and $u\left(\cdot\right)$ concave, it is immediate that the optimal b_i^* and d_i^* increase with h_i^*.

Therefore, when $\alpha\in[\tilde{\alpha_1},\frac{1}{2}]$, both foot-binding and dowry payments will be used by upper class women. By Bertrand competition, the marry-up benefits will be completely absorbed by these two price tools. There will be μp upper class women choose binding intensity b_u^*, dowry size d_u^*, where b_u^* and d_u^* satisfy the following conditions:

$$c^{'}\left(b_u^*\right)=u^{'}\left(d_u^*\right)$$

$$c\left(b_u^*\right)+u\left(d_u^*\right)=v(h,h)-v(h,(1-\alpha)h+\alpha l)$$

When $\alpha\in[\tilde{\alpha_2},\frac{1}{2}]$, both foot-binding and dowry payments will be used by lower class women, where $(1-\mu)p$ lower class women choose binding intensity b_l^*, dowry size d_l^*, satisfying the following conditions:

$$c^{'}\left(b_l^*\right)=u^{'}\left(d_l^*\right)$$

$$c\left(b_l^*\right)+u\left(d_l^*\right)=v(l,(1-\alpha)l+\alpha h)-v(l,l)$$

It is obvious to check that $b_u^*>b_l^*$ and $d_u^*>d_l^*$ when $\alpha\in[\tilde{\alpha_2},\frac{1}{2}]$.

(4) When $\alpha \in (\frac{1}{2}, 1)$, both foot-binding and dowry payments will be used by both classes, and μp of upper class brides choose binding intensity b_C^*, dowry size d_C^*; $p\,(1-\mu)$ of upper class brides choose binding intensity b_{NE}^*, dowry size d_{NE}^*; and $(\mu - p)$ choose not to bind feet and pay no dowry. For the lower class brides, precisely $p\,(1-\mu)$ of them choose binding intensity b_{FE}^*, dowry size d_{FE}^*. In particular, $b_C^* > b_{NE}^*$, $b_C^* > b_{FE}^*$, $d_C^* > d_{NE}^*$, and $d_C^* > d_{FE}^*$. These values satisfy the following conditions:

$$c^{'}\,(b_C^*) = u^{'}\,(d_C^*), \text{ and } c\,(b_C^*) + u\,(d_C^*) = v(h,h) - v(h,(1-\alpha)h + \alpha l);$$

$$c^{'}\,(b_{NE}^*) = u^{'}\,(d_{NE}^*), \text{ and } c\,(b_{NE}^*) + u\,(d_{NE}^*) = v(h,(1-\alpha)l + \alpha h) - v(h,(1-\alpha)h + \alpha l);$$

$$c^{'}\,(b_{FE}^*) = u^{'}\,(d_{FE}^*), \text{ and } c\,(b_{FE}^*) + u\,(d_{FE}^*) = v(l,(1-\alpha)l + \alpha h) - v(l,l)\ .$$

Proof of Corollary 1

Proof. From Proposition 3, we know that $r_l = min\{\frac{p[v(l,(1-\alpha)l+\alpha h) - v(l+\beta_1 l,l)]}{C + v(l+\beta_0 l,l) - v(l+\beta_1 l,l)},\ 1\}$, so it's immediate that r_l decreases in β_0. Next, since we have $r_l = min\{p + \frac{p[v(l,(1-\alpha)l+\alpha h) - v(l+\beta_0 l,l) - C]}{C + v(l+\beta_0 l,l) - v(l+\beta_1 l,l)},\ 1\}$, thus $\frac{\partial r_l}{\partial \beta_1}$ depends on the numerator. Consider Assumption 4 (Bounded Disutility), we have $\overline{C} = (1-p)[v(l, \frac{h+l}{2})) - v(l+\beta_0 l, l)]$. Therefore, when $C \leq min\{v(l,(1-\alpha)l + \alpha h) - v(l+\beta_0 l, l), \overline{C}\}$, r_l increases with β_1; when $C \in [v(l,(1-\alpha)l + \alpha h) - v(l+\beta_0 l, l), \overline{C}]$, r_l decreases with β_1.

Proof of Proposition 7

Proof. When the α is large enough that generating a flipping ranking between the new elites and fallen elites, that $\frac{1}{2} < \alpha < 1$, the competition will become the following:

First, due to complementarity, a lower class bride never seeks for marriage with champions and new elites. In particular, for a lower class bride matched with a champion through foot-binding, the marrying-up benefit of the bride's side should be able to compensate the marrying-down loss of the champion, i.e.: $v(l,h) - v(l+\beta_0 l, l) > v(h,h) - v(l,h)$. For a lower class bride matched with a new elite through foot-binding, the marrying-up benefits of the bride's side should be able to compensate the marrying-down loss of the new elite, i.e.: $v(l,(1-\alpha)l + \alpha h) - v(l+\beta_0 l, l) > v(h,(1-\alpha)l + \alpha h) - v(l,(1-\alpha)l + \alpha h)$. However, due to complementarity, both conditions will not be feasible. Thus cross-class marriage is not possible, and there only exists competition for lower class women competing for fallen elites.

Upper class brides now competes on both champions and new elites[35]. The unmarried brides then compete with lower class brides on the fallen elites. Suppose equilibrium foot-binding percentages in both class are r_u and r_l, respectively, then apply the indifference condition and assume interior solution:

$\frac{p}{r_u} v\left(h,h\right)+\frac{(1-\mu)p}{\mu r_u} v\left(h,(1-\alpha)l+\alpha h\right)+\left(1-\frac{p}{\mu r_u}\right) v\left(h,(1-\alpha)h+\alpha l\right)-C=v\left(h,(1-\alpha)h+\alpha l\right)$,
so that the proportion of foot-binding women in upper class is:

$r_u=\frac{p}{C}\{\mu[v(h,h)-v(h,(1-\alpha)h+\alpha l)]+(1-\mu)[v(h,(1-\alpha)l+\alpha h)-v(h,(1-\alpha)h+\alpha l)]\}$.
Add the boundary, we have:

$$r_u=$$
$$min\{\frac{p}{C}\{\mu[v(h,h)-v(h,(1-\alpha)h+\alpha l)]+(1-\mu)[v(h,(1-\alpha)l+\alpha h)-v(h,(1-\alpha)h+\alpha l)]\},\ 1\}.$$

For lower class women, in equilibrium the percentage of foot-binding women should make the marriage benefit with and without foot-binding indifferent. That is:

$$\frac{p}{r_l} v\left(l,(1-\alpha)h+\alpha l\right)+\left(1-\frac{p}{r_l}\right) v\left(l+\beta_1 l,l\right)-C=v\left(l+\beta_0 l,l\right), \text{ so that}$$
$$r_l=\frac{p[v(l,(1-\alpha)h+\alpha l)-v(l+\beta_1 l,l)]}{C+v(l+\beta_0 l,l)-v(l+\beta_1 l,l)}.$$

Add the boundary, we have:

$$r_l=min\{\frac{p[v(l,(1-\alpha)h+\alpha l)-v(l+\beta_1 l,l)]}{C+v(l+\beta_0 l,l)-v(l+\beta_1 l,l)},\ 1\}.$$

By complementarity of v it is easy to check that $r_l \leq r_u$ in this case. Comparing the proportion of lower class women foot-binding when $\frac{1}{2}<\alpha<1$ and $\alpha \leq \frac{1}{2}$, we also have for interior solutions, $r_l|_{\frac{1}{2}<\alpha<1} < r_l|_{\alpha\leq\frac{1}{2}}$, since now the fallen elites are less attractive compared to the new elites for lower class women.

Proof of Corollary 2

[35]Here the champions and the new elites act as a whole group for the brides. The reason is that foot-binding in this model is binary thus competition is insufficient. One might expect the upper class brides further compete on the champions using other tools. There are two ways to address the issue: First, if we model foot-binding as a continuous choice, where brides can adopt different sizes of bound-foot, then competition towards the champions drives the brides to bind their feet smaller and smaller. This is also consistent with the historical records. Second, we can further model the dowry process shortly before marriage, where bridal families pay dowry to compete for the champions. Since brides are assumed homogeneous in intrinsic quality, Bertrand competition bids away any extra benefit, and the dowry amount would equalize the marriage value difference between marrying a new elite and marrying a champion. Again such difference is increasing in social mobility parameter α, which suggests that dowry payment increases as Keju system expands. This is also consistent with the stylized facts.

Proof. When $\frac{1}{2} < \alpha < 1$, recall from Proposition 7 that $r_l = min\{\frac{p[v(l,(1-\alpha)h+\alpha l)-v(l+\beta_1 l,l)]}{C+v(l+\beta_0 l,l)-v(l+\beta_1 l,l)},\ 1\}$. So it is immediate that r_l decreases in β_0. Next, $r_l = min\{\frac{p[v(l,(1-\alpha)h+\alpha l)-v(l+\beta_1 l,l)]}{C+v(l+\beta_0 l,l)-v(l+\beta_1 l,l)},\ 1\} = min\{p + \frac{p[v(l,(1-\alpha)h+\alpha l)-v(l+\beta_0 l,l)-C]}{C+v(l+\beta_0 l,l)-v(l+\beta_1 l,l)},\ 1\}$. Consider Assumption 4 (Bounded Disutility), we have $\overline{C} = (1-p)[v(l, \frac{h+l}{2})) - v(l+\beta_0 l, l)]$. Therefore, when $C \leq min\{v(l,(1-\alpha)h+\alpha l) - v(l+\beta_0 l, l), \overline{C}\}$, r_l increases with β_1; when $C \in [v(l,(1-\alpha)h+\alpha l) - v(l+\beta_0 l, l), \overline{C}]$, r_l decreases with β_1. □

8.5 The Republican Archives

In this session, we discuss the feature of our archival sample in detail. As discussed, our data on foot-binding is constructed from archives conducted by the Republican government covering part of the counties of four provinces, which could induce two potential concerns: first, some counties are missing and not covered by the archive[36]; second, among the counties covered by the archive, some reported clear information on foot-binding, yet some with ambiguous information. For our analysis, sample selection would only be an issue if the selection were based on some unobserved characteristics that are correlated with determinants of foot-binding at county level. As a robustness check for the selection issue of the first type, we conduct a balance check for out-of-archive and in-archive counties by province in Table A5. As shown in Table A5, the two types of counties do not display significant differences in terms of suitability of rice to wheat, cotton suitability, and county exam quota for counties of Hunan province. In Shandong, the means of county exam quota differ by group while agricultural suitability do not; and in Chahaer and Yunnan, only difference in means of agricultural suitability is significant. There is no clear pattern in common for selection on the in-archive counties.

For the second type of selection issue, we label counties with ambiguous information on foot-binding as in the "ambiguous category", and conduct t-test for key variables. Table A6 shows that none of the variables show significant differences in mean across the two groups of counties.

8.6 A Brief Life History of Shoe Owners in Archaeology Findings

The owner of the shoes in Fuzhou is Huang Sheng (Fujian Museum, 1982). Her father Huang Pu was born in 1192 in Fuzhou Prefecture, and was the *Zhuangyuan* (ranking top one among all *Jinshi)* in the year of 1229, when he was 37. Sheng was married into the imperial clan when she was 16, to Zhao Yujun, who was the 11th generation grandson of the found father of Song (Zhao Kuangyin). In a word, born in an upper class family, Sheng married into another powerful family in the bureaucratic system.

The owner of the shoes in Quzhou is Yang (Quzhou Heritage Management Office, 1982,

[36]This issue may stem from the wars and disturbances during the early 20^{th} century, that the archives of some counties are missing, or they didn't conduct the survey in the first place. But unfortunately, we cannot distinguish such difference based on the sources we have.

2006). Yang was born in 1208, and married to Shi Shengzu (1192-1274) as her second wife, as his first wife died early. Both Yang and Shi Shengzu were born in Chengdu Prefecture. Both grandfather and father of Yang were not bureaucrats, while Shi was holding positions in Chengdu Prefecture. The couple moved to Quzhou during their later life.

The owner of the shoes in De'An is Zhou (Sun, 1990, Yu, 1990). Zhou was born in 1240 in Wuning, and married to Wu Chou in 1257, who was at age of 30 and a local magistrate. Zhou was the second wife of Wu Chou, whose first wife died early. Her father is Zhou Yinghe (1213-1280), who was entitled as a *Jinshi* in 1250, and later became a local magistrate. In this case, Zhou got married to a young official at a similar bureaucratic level to her father's.

8.7 A Spatial Discontinuity Case: Agricultural Regimes and Foot-binding

This section complements the empirical analysis by a case of spatial discontinuity. As Figure A8 illustrates, the Jiangsu Province sit across the division of the Northern and Southern China along the Huai River, where wheat and rice dominated its its northern and southern part respectively. With such geographic proximity, comparing different agricultural regimes of the North and the South along the river division provides us an opportunity to investigate differential intensity of foot-binding. Indeed, as recorded by Jiangsu gazetteer, it was historically observed that women in the North specialized in household handicrafts, while those in the South worked more in farms. Regarding foot-binding prevalence in rural area, the northern part had a greater level of prevalence than the southern part.

8.8 Appendix References (History, Anthropology, Archaeology)

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8.9 Appendix Tables and Figures

Table A1: Historical Sources of Foot-binding: A Comparison

Sources on Foot-binding	**Examples**	**Authors/Compilers**	**Contents**	**Time Range**	**Accessbility**
1. Official records by the Republican Government	Republican government archives(1931-1934)	The Republican government prohibited foot-binding in the 1930s. Original report from local county government. Compiled by the Ministry of Interior, Republic of China.	Describing foot-binding in the history, and anti-footbinding process.	Not restricted, mostly Qing-Republican.	The Second Historical Archives of China, Nanjing
2. Semi-official records: gazetteers (province, prefecture, county)	Historical gazetteers	local gentries, scholars and officials	Foot-binding as a folk practice and anti-footbinding process.	The late Qing-Republican.	Around 230 localities
3. Jottings(Biji), literature, privately compiled history	Qian, Yong(1759-1844), Xu, Ke(1869-1928), Yao,Ling-hsi(1899-1963), Hu,Pu-an(1878-1947)	Scholars, historians, philologists	A wide range of foot-binding history	From the Song to the Republican.	Mostly published during the Qing and Republican.
4.A. Anthropology, personal history, and interviews (historical)	Turner(1997)	Foreign visitors/scholars, missionaries, Travellers, foot-binding women	First-hand sources		See Turner (1997) and Missionary journals.
4.B. Anthropology, personal history, and interviews (contemporary)	Gates(2015), Bossen&Gates(2017)	Personal history described by footbinding women themselves	First-hand sources	Rural elderly women in 27 villages, 9 provinces	e.g. Bossen&Gates(2017).
5. The folkloristic evidence and oral literature, e.g. ballads and bound-feet beauty contest.	Zhang(2015)	The folk. Compiled by domestic or foreign observers.	Describtion in various ways.	Unknown.	Zhang(2015)
6. Archaeological evidence (bound feet shoes/lotus shoes)	Ebrey(1992)	Officials' wives and daughters.	The owener of shoes, her family status, the location of shoes	The Song (960-1279)	Ebrey(1992)

Table A2: The Income of Gentry Class by Occupation

			Avg. Annual Income/Avg. Labor Income		
Category	Gentry Occupation	Average Annual Income (in taels)	Col.3/Lower Bound	Col.3/Upper Bound	Col.3/Category 14
(1)	(2)	(3)	(4)	(5)	(6)
1	Rank (Central/local 1st)	180	36	18	12.00
2	Rank (Central/local 2nd)	150	30	15	10.00
3	Rank (Central/local 3rd)	130	26	13	8.67
4	Rank (Central/local 4th)	105	21	10.5	7.00
5	Rank (Central/local 5th)	80	16	8	5.33
6	Rank (Central/local 6th)	60	12	6	4.00
7	Rank (Central/local 7th)	45	9	4.5	3.00
8	Rank (local 8th)	40	8	4	2.67
9	Rank (local 9th or none)	33.11	6.62	3.31	2.21
10	Gentry services	120	24	12	8.00
11	Secretaries to officials	250	50	25	16.67
12	Teaching	100	20	10	6.67
13	Practice of traditional medicine	200	40	20	13.33
14	Scholarship Awardees	15	3	1.5	1.00

Note: Data source: Calculation based on Chang (1962). The lower bound of the male labor annual income is 5 taels and the upper bound is 10 taels.

Table A3: Proportion of Gentry and Literati by Province

				%Gentry among Male Pop.		%Quota among Male Pop. (16-25)	
Province	**#Quota**	**#Gentry**	**Pop.**	**SR=110**	**SR=130**	**SR=110**	**SR=130**
Fengtian	131	–	–	–	–	–	–
Zhili	5263	–	36900	–	–	–	–
Jiangsu	2594	75831	29600	0.489%	0.453%	0.084%	0.078%
Anhui	2385	53713	36600	0.280%	0.260%	0.062%	0.058%
Zhejiang	3330	86969	30400	0.546%	0.506%	0.105%	0.097%
Jiangxi	2498	78382	26500	0.565%	0.523%	0.090%	0.083%
Fujian	2196	55152	25800	0.408%	0.378%	0.081%	0.075%
Henan	3017	70874	29100	0.465%	0.431%	0.099%	0.092%
Shandong	3386	64949	36200	0.343%	0.317%	0.089%	0.083%
Shanxi	2842	51366	10300	0.952%	0.882%	0.263%	0.244%
Hubei	2011	52027	28600	0.347%	0.322%	0.067%	0.062%
Hunan	2225	63372	20000	0.605%	0.561%	0.106%	0.098%
Shanxi and Gansu	3450	70269	29800	0.450%	0.417%	0.111%	0.102%
Sichuan	2527	55263	22300	0.473%	0.438%	0.108%	0.100%
Guangdong	2453	77380	21100	0.700%	0.649%	0.111%	0.103%
Guangxi	1885	39638	8100	0.934%	0.866%	0.222%	0.206%
Yunnan	2453	43165	6200	1.329%	1.232%	0.378%	0.350%
Guizhou	1393	25448	4800	1.012%	0.938%	0.277%	0.257%

Note: Data source: Chang (1955). To facilitate our calculation, we take a lower bound assumption of the sex ratio to be 110 men per 100 women and an upper bound to be 130, and assume that the proportion of males aged 16-25 account of 20% of the total male population.

Table A4: Number of days of man-labor required per crop hectare for major crops

	Major Crops in Rice Region					
	Rice	Rice, early	Rice, late	Rice, glutinous		
Average	186.4	120.7	104.9	201.6		
	Major Crops in Wheat Region					
	Wheat	Spring Wheat	Maize	Kaoliang	Millet	Millet, proso
Average	95.4	114.6	108.7	101.9	103.9	127.8

Source: Buck, J. L. (1937). Land Utilization in China: A Study of 16,786 Farms in 168 Localities, and 38,256 Farm Familites in Twenty-two Provinces in China, 1929-1933–Statistics (Vol. 2). Commercial Press, Limited, Agents in the United States, The University of Chicago Press.

Table A5: Out-of-Archive and In-Archive Counties

	Out-of-Archive Counties		**In-Archive Counties**		**T-test**
	N1	**Mean1**	**N2**	**Mean2**	**p-value**
Shandong					
Relative Suitability (Rice-Wheat)	17	-0.86	90	-0.979	0.62
Cotton Suitability	17	1.056	90	0.938	0.15
County Exam Quota	17	-0.355	87	0.053	0.03
Hunan					
Relative Suitability (Rice-Wheat)	45	2.412	26	2.601	0.43
Cotton Suitability	45	-0.447	26	-0.415	0.32
County Exam Quota	42	-0.138	25	0.01	0.56
Chahaer					
Relative Suitability (Rice-Wheat)	142	-0.583	10	-0.697	0.4
Cotton Suitability	142	0.429	10	-1.74	0
County Exam Quota	126	0.316	10	0.149	0.56
Yunnan					
Relative Suitability (Rice-Wheat)	29	0.957	80	-0.143	0
Cotton Suitability	29	-0.856	80	-1.127	0.07
County Exam Quota	7	-0.859	69	-0.41	0.4

Note: This table provides a balance check for out-of-archive and in-archive counties by the four provinces covered by the Republican archives. The key variables for comparison include relative suitability, cotton suitability, and county exam quotas. Column 5 provides p-value for the t-test between two groups. All variables are standardized.

Table A6: Ambiguous-Info. Counties and Clear-Info. Counties

	Ambiguous-Info. Counties		**Clear-Info. Counties**		**T-test**
Variables	**N1**	**Mean1**	**N2**	**Mean2**	**p-value**
Relative suitability (rice-wheat)	33	-0.038	148	-0.359	0.29
Cotton suitability	33	0.126	148	-0.176	0.17
County exam quota	33	-0.359	148	-0.075	0.16
Prefecture population 1820	33	0.457	148	0.054	0.05
Prefecture land tax p.c. 1820	33	-0.098	148	-0.227	0.41
Number of chaste women	33	0.016	148	-0.181	0.16
Mogolian migration history	33	-0.38	148	-0.272	0.52
Distance to courier routes	33	0.047	148	-0.093	0.45
Distance to provincial capital	33	-0.474	148	-0.488	0.65

Note: This table provides a balance check for ambiguous-info. counties and clear-info. counties, among all counties covered by the Republican archives. Column 5 provides p-value for the t-test between two groups. All variables are standardized.

Table A7: First Stage Results

	Dependent Var: County Exam Quota			
	(1)	(2)	(3)	(4)
Ming Presented Scholar	0.484***	1.441**	1.464**	1.455**
	(0.049)	(0.369)	(0.408)	(0.423)
Distance to Ming garrisons	-0.399**	-0.369**	-0.358*	-0.361*
	(0.087)	(0.102)	(0.120)	(0.119)
Ming Presented Scholars x Dist. Garrisons	0.280*	0.273**	0.271**	0.265**
	(0.113)	(0.051)	(0.063)	(0.067)
Relative suitability (rice-wheat)	0.011	0.051	0.046	0.041
	(0.036)	(0.068)	(0.056)	(0.058)
Cotton Suitability	-0.181	-0.322	-0.261	-0.255
	(0.156)	(0.183)	(0.204)	(0.214)
Pref. Population 1820	0.094	0.044	$-0.232^{\dagger}$	-0.243
	(0.165)	(0.098)	(0.118)	(0.128)
Land Tax pc. 1820	-0.018	-0.041	-0.064	-0.050
	(0.128)	(0.072)	(0.062)	(0.058)
Distance to courier routes		-0.057	-0.091	-0.081
		(0.120)	(0.131)	(0.125)
Distance to provincial capital		-0.226	0.313	0.320
		(1.128)	(1.063)	(1.069)
Ming Presented Scholars x Dist. Routes		-0.273**	-0.286**	-0.281**
		(0.061)	(0.059)	(0.064)
Ming Presented Scholars x Dist. Prov. Capital		1.997*	2.051*	2.036*
		(0.628)	(0.699)	(0.729)
Chaste Women			0.410	0.399
			(0.252)	(0.258)
Mogolian Migration				0.040+
				(0.018)
Prov. FE	Yes	Yes	Yes	Yes
Observations	148	148	148	148
R-squared	0.397	0.432	0.449	0.450

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses, clustered by province. This table presents the first stage results. All explainatory variables are standardized.

Table A8: Reduced Form Results

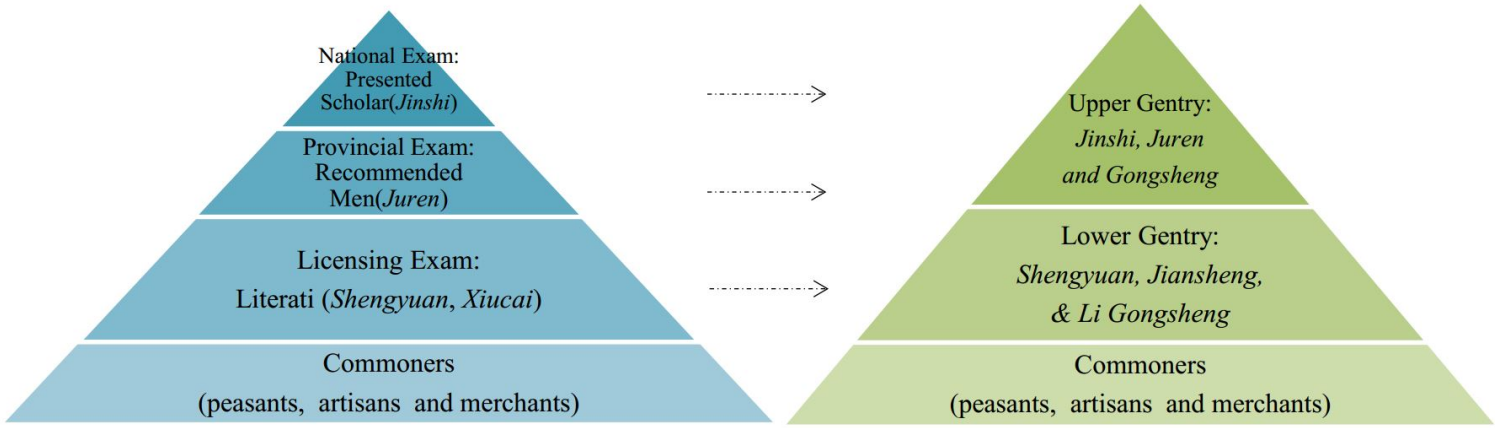
	Dependent Var: Foot-binding Prevalence			
	(1)	(2)	(3)	(4)
Ming Presented Scholar	0.016	-0.051	-0.049	-0.048
	(0.013)	(0.110)	(0.105)	(0.105)
Distance to Ming garrisons	-0.064*	-0.060*	-0.059*	-0.059*
	(0.025)	(0.024)	(0.023)	(0.023)
Ming Presented Scholars x Dist. Garrisons	0.044**	0.044+	0.044+	0.045+
	(0.012)	(0.021)	(0.021)	(0.022)
Relative suitability (rice-wheat)	-0.080**	-0.066+	-0.067+	-0.066+
	(0.018)	(0.034)	(0.033)	(0.034)
Cotton Suitability	0.158**	0.132*	0.135*	0.135*
	(0.039)	(0.049)	(0.043)	(0.044)
Pref. Population 1820	-0.071	-0.074	-0.091	-0.090
	(0.067)	(0.077)	(0.088)	(0.086)
Land Tax pc. 1820	0.047	-0.002	-0.003	-0.005
	(0.030)	(0.044)	(0.044)	(0.046)
Distance to courier routes		-0.025	-0.028	-0.029
		(0.075)	(0.083)	(0.084)
Distance to provincial capital		-0.149	-0.116	-0.116
		(0.209)	(0.326)	(0.327)
Ming Presented Scholars x Dist. Routes		0.003	0.002	0.002
		(0.024)	(0.025)	(0.026)
Ming Presented Scholars x Dist. Prov. Capital		-0.131	-0.128	-0.126
		(0.204)	(0.194)	(0.194)
Chaste Women			0.025	0.027
			(0.074)	(0.077)
Mogolian Migration				-0.005
				(0.010)
Prov. FE	Yes	Yes	Yes	Yes
Observations	148	148	148	148
R-squared	0.412	0.419	0.420	0.420

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses, clustered by province. This table presents the first stage results. All explainatory variables are standardized.

Table A9: Correlation Table

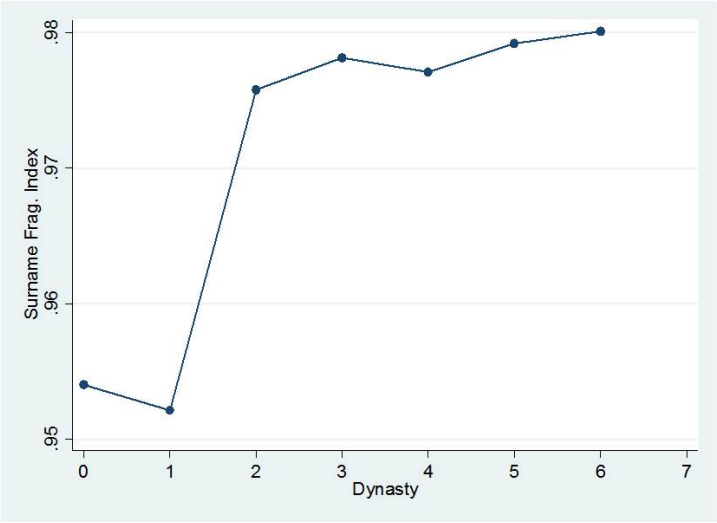
	Variables	A	B	C	D	E	F	G	H	I	J	K
A	County Exam Quota	1										
B	Pref. Pop 1820	0.22	1									
C	Land Tax pc. 1820	0.20	0.68	1								
D	Ming Presented Scholar	0.42	0.48	0.46	1							
E	Distance to Ming garrisons	-0.45	-0.12	-0.15	-0.16	1						
F	Relative rice suitability	-0.15	-0.16	-0.10	-0.09	0.23	1					
G	Cotton Suitability	0.07	0.72	0.71	0.40	0.03	-0.03	1				
H	Distance to courier routes	-0.26	-0.32	-0.41	-0.20	0.36	0.18	-0.35	1			
I	Distance to prov. capital	-0.21	-0.15	-0.33	-0.12	0.25	0.23	-0.12	0.75	1		
J	Chaste Women	0.32	0.80	0.56	0.39	-0.21	-0.22	0.42	-0.35	-0.38	1	
K	Mogolian Migration	0.22	0.37	0.36	0.21	-0.17	-0.20	0.15	-0.31	-0.31	0.48	1

Figure A1: The Civil Exam System and the Social Ladder



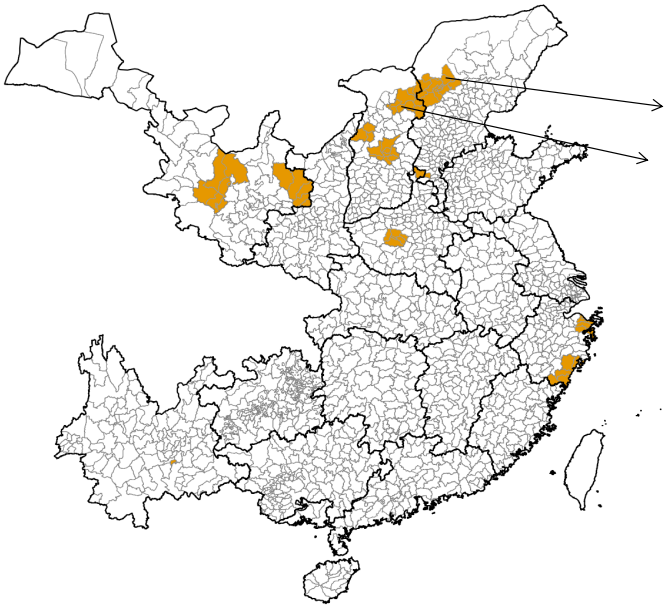
Note: Illustration based on Chang(1955). Description of degree holders of the exam system is presented in Section 2, including Presented Scholars (*Jinshi*), Recommended Men (*Juren*), and Literati (*Shengyuan*). Tribute Students (*Gongsheng*) refer to those who are accepted into the Imperial Academy (*Guozijian*), and *Jiansheng* refers to those who purchased the Literati degree without taking actual exams at the entry level.

Figure A2: Men's Mobility Trend: Evidence from CBDB



Note: In the above graph, 0=Qin-Han Dynasty(BC221-220), 1=Sui-Tang Dynasty(581-907), 2=Song Dynasty(960-1127), 3=Yuan Dynasty(1271-1368), 4=Ming Dynasty(1368-1644), 5=Qing Dynasty(1636-1911) and 6=Post-Qing Dynasty(1911-1949). Data source: CBDB (version: 2015-03-18). We calculate the surname fractionalization index with a sample of male celebrities with single character surnames (a proxy of Han ethnicity). The surname fractionalization index is constructed following Alesina et al. (2003): $Frac_d = 1 - \sum_{i=1}^{N} S_i^2$, where S_i is the share of surname group i in dynasty d.

Figure A3: The Distribution of Bound Feet Beauty Contest (Sai Zu Hui)

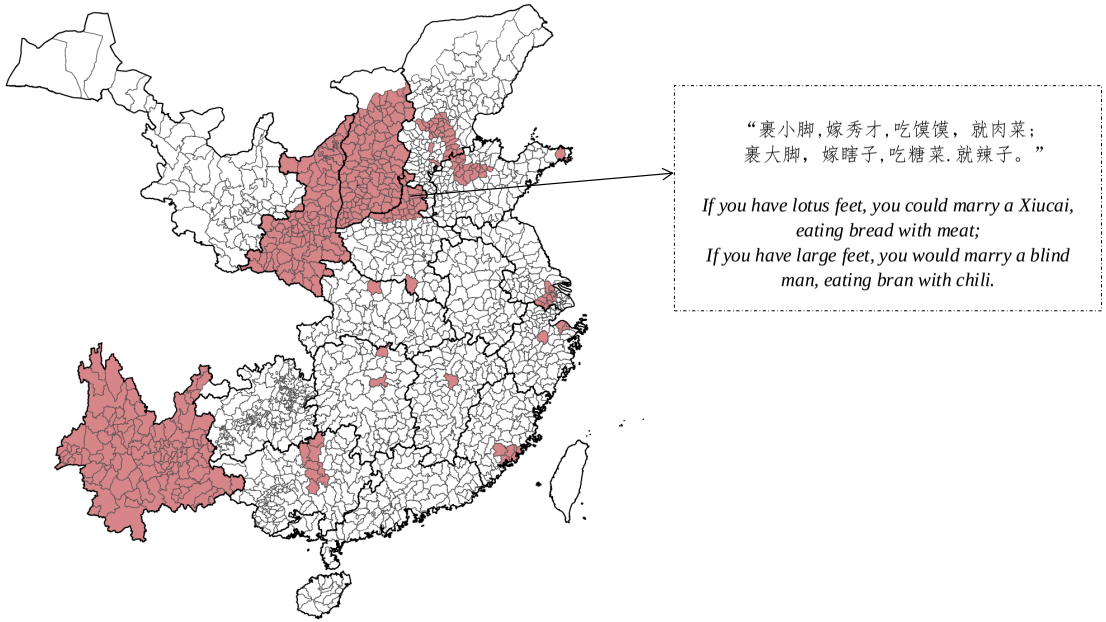


Picture: Contest Scenes 《赛会饬景—双足伸向帘外》
Author: Xing Xing Dian 星兴典
Lines in Picutre:
潘妈一声令下东厢房戈香莲伸向外门蝴蝶履，
赛脚会顿开始西厢屋白金宝晾赛淡绿小弓鸳。

With Ms. Pan's ordering, Ge Xianglian of east room lets her feet out, wearing butterfly shoes;The bound feet beauty contest started, Bai Jinbao of west room, shows off light green arched shoes.

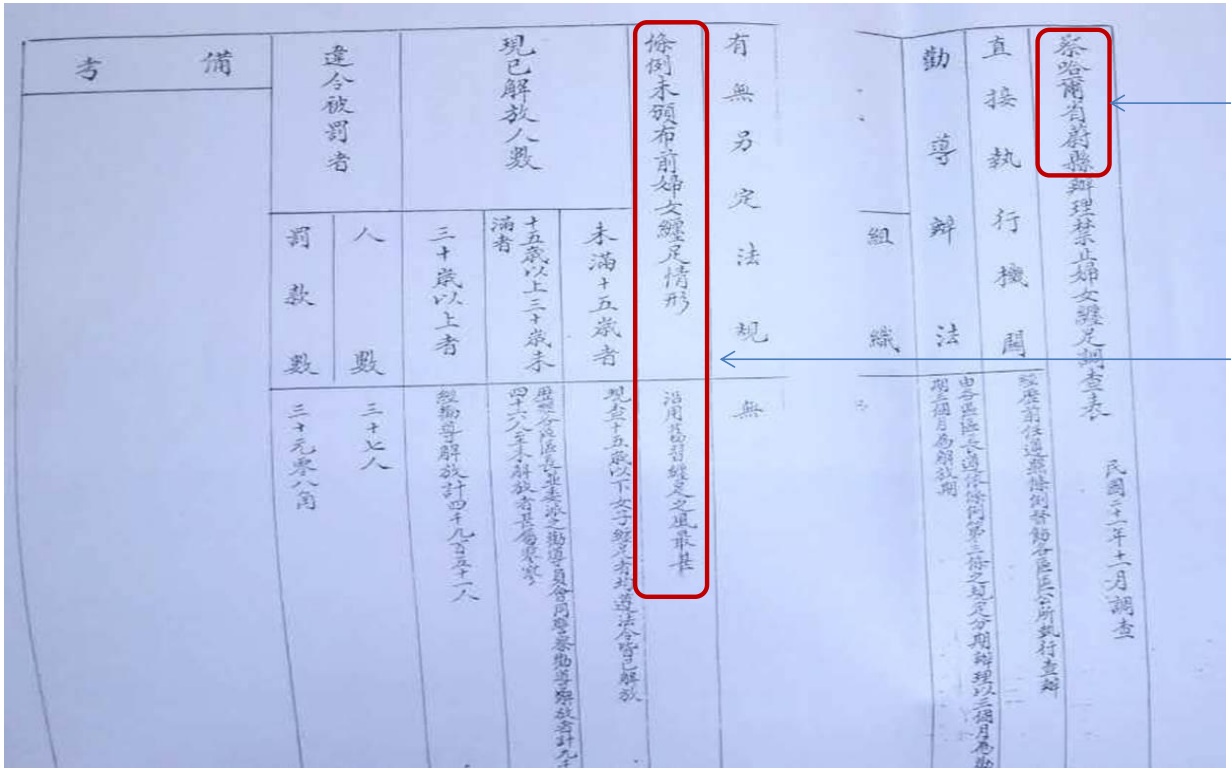
Note: The shaded counties are those with Bound Feet Beauty Contest (in Chinese, *Sai Zu Hui*), as recorded by Zhang(2015),Nagao(1973) and Yao(1936). Base map here is CHGIS v4. The source of picture is from the Foot-binding Forum (organized by Dr. Ke Jisheng), http://www.footbinding.com.tw/.

Figure A4: The Distribution of Folk Ballads on Foot-binding



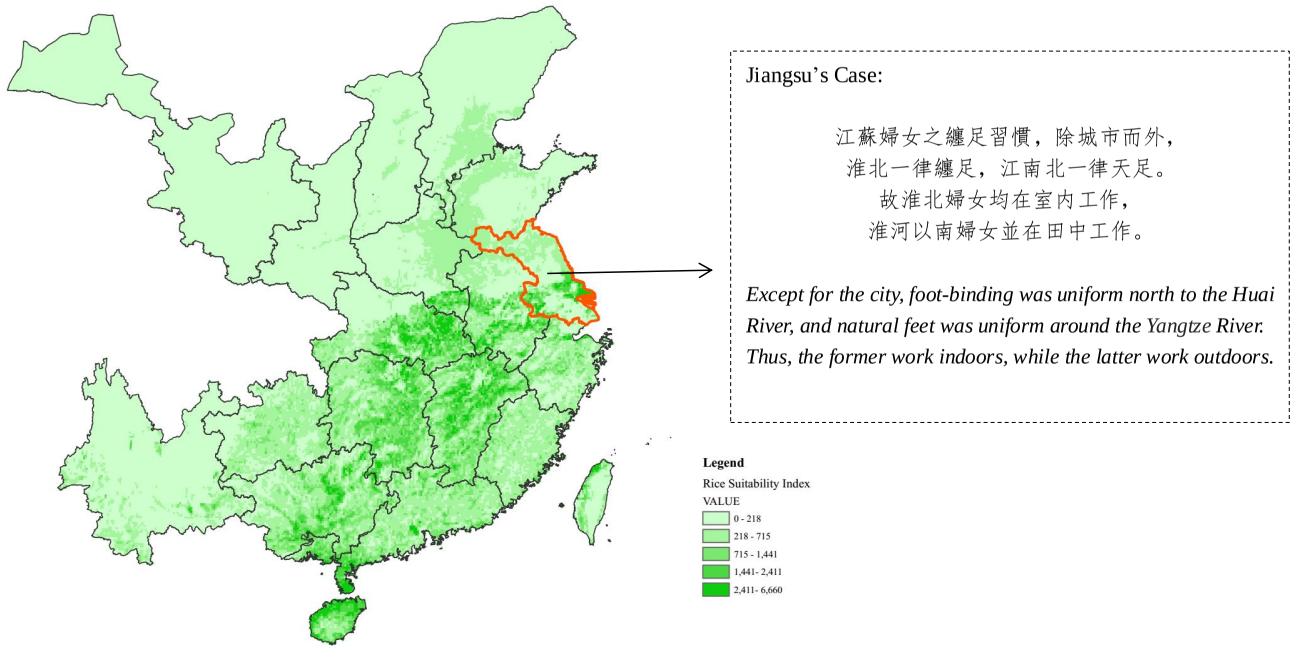
Note: The shaded counties are those with ballads on foot-binding and marriage. Base map is CHGIS v4. For instance, in Zhangde county (Henan): ”If you have lotus feet, you could marry a Literati (Xiucai), eating bread with meat; If you have large feet, you would marry a blind man, eating bran with chili”. In historical narratives, such phrases were often used to illustrate how mothers persuaded themselves and their daughters to bind their feet. Based upon the collection by Zhang (2015), we present Figure A1 as a summary of the regional distribution of foot-binding related ballads.

Figure A5: The Case of Yu County (Chahaer)



Note: This figure shows an example of the archives: Yu county in Chahaer.

Figure A6: The Case of Jiangsu Province



Note: The data in this map comes from geographic distribution of crop suitability from the FAOs GAEZ (Global Agro-Ecological Zones). The two rivers denotes Huai River and Yangtzi River from north to south respectively. The source of this qualitative case is provincial gazetteer of Jiangsu province published in the Republican years.