Coeducation, Female Human Capital, and the Evolution of Gender Norms*

Bin Huang † Yuchen Lin ‡

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Abstract

This paper investigates how the inclusion of women in higher education affects men's gender attitudes and generates spillover effects through male students' personal networks, improving more women's human capital accumulation. We examine a coeducation reform at Peking University in 1920, which admitted female students into universities for the first time in China. To measure spillovers, we focus on the indirect effect through male students and compare female educational outcomes in the home counties of first-exposed and last-non-exposed male graduates. Our quasi-experimental analyses show that there is an 11.4 percentage point higher probability of having female university students in exposed counties compared with non-exposed counties. The main mechanism is the spread of more progressive gender norms through the personal networks of male students, reflected by the positive shift in male students' gender attitudes and the increase in university enrollment predominantly among female students from the same clan. Our findings highlight the importance of exposure to gender diversity in altering gender attitudes and demonstrate how personal networks amplify the diffusion of these changes and improve real economic outcomes. However, the spillover did not benefit the mass schooling of girls, as female enrollment in primary schools was unaffected, suggesting the limited capacity of elites to shape cultural change.

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†Department of Economics, University of Zurich, bin.huang@econ.uzh.ch
‡Department of Economics, University of Warwick, yuchen.lin@warwick.ac.uk

1 Introduction

The inclusion of women in higher education has fundamentally increased women's welfare and their participation in the economy over the past two centuries (Goldin, 2004, 2006). Since the mid-19th century, the expansion of coeducational universities not only improved women's educational attainment (Goldin and Katz, 2011; Goldin, 2014), but also generated inter-generational benefits and development in academic research (Currie and Moretti, 2003; Truffa and Wong, 2024). Apart from the direct impact on female students, gender integration in higher education may also change male students' gender attitudes and thus generate spillovers through their behaviors. Previous studies have discussed how exposure to out-group members can shape individual attitudes and improve inter-group understanding (Williams Jr, 1947; Allport et al., 1954; Pettigrew and Tropp, 2006; Paluck et al., 2021).[1] However, less is explored on whether and how exposed individuals would spread the more egalitarian attitudes that affect a broader population as well as generate economic outcomes beyond self-reported attitudes. Understanding how individuals behave after being exposed to diversity is crucial for designing and evaluating inclusive policies, as this can generate spillovers that benefit more people without direct exposure or interaction, thereby amplifying the welfare induced by the policies.

In this study, we examine the spillover effect of exposure to gender diversity through men's changing attitudes and behaviors. We exploit a natural experiment that admitted female students into universities for the first time in China: the coeducation reform at Peking University (PKU) in 1920.[2] Comparing female higher education outcomes in the home counties of first exposed and last non-exposed male PKU graduates, we find the coeducation reform increased women's human capital accumulation through an indirect effect of the exposed male students. We highlight a novel perspective on men's gender attitudes and their social networks in the diffusion of more

[1] As for empirical studies in economics, Van Laar et al. (2005), Boisjoly et al. (2006), and Corno et al. (2022) report reduced racial stereotypes using the random assignment of college roommates. Finseraas and Kotsadam (2017), Carrell et al. (2019), Finseraas et al. (2019), and Dahl et al. (2021) have similar findings on individual attitudes toward minority groups in a military setting. Scacco and Warren (2018), Rao (2019), Mousa (2020), and Lowe (2021) also find the positive effects of social contact on reducing discrimination and cultivating prosocial attitudes in other settings.

[2] In this paper, we use the terms "university," "college," and "higher education institute" interchangeably. They refer to the same set of institutes that provide higher education.

gender-equal attitudes. Specifically, we observe a notable shift in these male students' gender attitudes and a rise in university enrollment predominantly among female students in the male students' social networks.

Our causal identification relies on the unexpected timing of PKU coeducation reform in February 1920, which provides exogenous variation in male students' exposure to gender diversity at the university. Students who graduated just after the reform had direct coeducational experience, studying and interacting with the first cohort of female students on campus, while those who graduated just before the reform did not. This also alleviated the self-selection problem, as the decision to transform into coeducation was made by the President of PKU after both cohorts were admitted, suggesting their anticipation of the reform was the same *ex ante*. As there were no female students in Chinese universities before 1920, our baseline specification adopts a quasi-experimental approach to compare female higher education outcomes between home counties of male PKU students who graduated in 1919 and those who graduated in 1920. Several balance checks confirm the comparability between treatment and control counties and cohorts. Moreover, the reform happened during a period when Chinese society was experiencing the spread of liberal ideologies (Chow, 1960). Our empirical strategy enables us to isolate the effect of exposure to gender diversity separately from general exposure to broader social changes.

To analyze the impact of the coeducation reform on women's education, we construct a comprehensive, individual-level dataset of profiles of over 80,000 students admitted to Chinese universities between 1892 and 1936. We compile the data based on large-scale digitization of 183 university registration records, alumni directories, and graduation yearbooks from more than 60 Chinese higher education institutes. Our novel data fills the gap left by the lack of census data and systematic administrative records on university students in 20th-century China. Using the hometown information in the students' profiles, we map students' hometowns to counties based on administrative divisions as of 1911. This enables us to identify the home counties of exposed and non-exposed male PKU students and aggregate a county-year panel dataset on female higher education between 1920 and 1936.

Our main finding is that exposure to coeducation reform increased female human capital in exposed male students' home counties. In counties exposed to reform

through male graduates, the probability of having at least one female student admitted to any Chinese university increased by 11.4 percentage point per year, corresponding to an increase of 0.46 standard deviations. We confirm that the positive effect was caused by the exposure to coeducation reform by ruling out confounding factors, including the specific features of treatment or control cohorts, the direct effect of the first female cohorts, the effects of contemporaneous social movements, and the overall progressive change within PKU. Breaking down the effects by each year between 1920 and 1936, we find that the magnitude kept increasing for a decade after reform, corresponding to the lagged supply of female educational opportunities in the late 1920s. We also show that the positive effect is only evident among early cohorts who experienced the shift from single-gendered education to coeducation by analyzing the heterogeneous effects across exposed male cohorts that graduated between 1920 and 1936. This finding emphasizes the importance of the initial entry of women into male-dominated fields in shaping the attitudes and behaviors of men. Lastly, we provide additional evidence on the parallel trends assumption through an event study using the data on female Chinese students in Japanese universities in 1900-1936 and find a similar positive effect as baseline estimates.

Coeducation reform generated positive spillovers on female higher education in the home counties of exposed male students by inducing positive changes in male students' attitudes toward female education. And elite social networks further facilitated the spread of these new progressive norms. First, we show that exposure to the coeducation reform improved male students' attitudes toward female education. We leverage individual biographies and periodicals to construct three proxies on male students' gender attitudes. These proxies are documented advocacy for female education, marriage to a female university graduate, and career choice of teaching in girls' schools after graduation. We find that exposure to the coeducation reform increased the probability of possessing more positive attitudes toward female education by 10 to 20 percentage points, depending on the proxy. Second, we argue that progressive gender attitudes were mainly diffused through elite social networks in the home counties of exposed male students. We focus on clanship, which was an important personal network in Chinese society based on kinships (Fei, 1985; Greif and Tabellini, 2010, 2017). It has been difficult to directly measure clanships at the individual level using historical

data (Chen et al., 2024), and we propose a novel approach that exploits the surnames and home counties of male PKU graduates and female university students to identify whether they originated from the same clan. Utilizing a surname-county-year panel dataset, we demonstrate that the positive effect on women's higher education is mainly driven by increased university enrollment among female students from the same clan as male graduates.

We then characterize three county-level characteristics that would amplify the positive spillover. First, compiling data on the time each Chinese university turned to coeducation, we find that increasing proximity to universities admitting female students increased the positive effect by 6.74 percentage points. Second, constructing a shift-share measure of labor demand for skilled female workers, we uncover that a larger labor demand increased the positive effect by 4.71 percentage points. Third, we suggest that the positive effect brought by male students through their social networks was more effective in countries with stronger traditional gender norms, highlighting the importance of personal experience in changing gender norms.

Finally, we conclude our analysis by showing the limitations of exposed male students in promoting broader social changes. We find a null effect on female enrollment in primary schools, reflecting the limited spillover of elite attitudes on the mass education of girls. Based on a textual analysis of the universe of articles in women's periodicals published in this period, we show that the null effect reflects the stagnation in gender norms on women's education perceived by the general public, who was outside the elite networks of male PKU graduates.

Together, our results indicate that the first coeducation reform in Chinese universities generated positive spillovers on female educational attainment through the exposed male students. The effects we observe are economically meaningful. Based on our baseline estimation, a back-of-the-envelope calculation suggests that 39% of a county's increased probability of having female students admitted to university between 1920 and 1936 can be attributed to the positive spillover of coeducation reform.

This paper contributes to four bodies of economic literature. First, we speak to the literature on whether intergroup exposure reduces prejudice and discrimination. Utilizing the random assignment of individuals from diverse ethnic or socioeconomic backgrounds in schools or the military, previous studies have empirically documented

how exposure to and interaction with out-group members can shape personal attitudes and reduce intergroup stereotypes (Van Laar et al., 2005; Boisjoly et al., 2006; Scacco and Warren, 2018; Carrell et al., 2019; Finseraas et al., 2019; Rao, 2019; Lowe, 2021; Corno et al., 2022; Bursztyn et al., 2024). Specifically, there is an increasing discussion of whether exposure to women in male-dominated fields changes men's stereotypes of gender roles (Beaman et al., 2009; Dahl et al., 2021; Greenberg et al., 2024). We extend the literature by analyzing the spillover of intergroup contact in a broader social context, which received scarce discussion with controversial findings.[3] We show that, after being exposed to gender diversity at university, male students not only changed their gender attitudes but also spread progressive attitudes through their social networks. This spread improved the human capital accumulation of a broader female population. Hence, we highlight how social networks help to amplify the positive effects of exposure to diversity and affect real economic outcomes.

Second, our work builds on the active literature on the role of elites in shaping economic development (Jones and Olken, 2005; Besley et al., 2011; Squicciarini and Voigtländer, 2015) and political outcomes (Dippel and Heblich, 2021; Bai et al., 2023; Cagé et al., 2022). The most related work is Bai et al. (2023), who connect elite social networks at the individual level with political power at the county level in late 19th-century China. Based on theoretical work (Acemoglu and Jackson, 2015), we extend the discussion to the cultural influence of elites and their limitations by providing new empirical evidence. We show that elites' networks can contribute to the spread of progressive norms that benefit elite women. Moreover, we demonstrate the limitations of elites in affecting the general public.

Third, we contribute to the broad literature on the cultural barriers to women's empowerment. Male-biased gender norms restrict female labor force participation and human capital accumulation (Field and Ambrus, 2008; Fernández and Fogli, 2009; Bernhardt et al., 2018). Recent empirical work has analyzed how women empowerment policies can alter restrictive gender norms through certain interventions.[4] In a society

[3]For example, Mousa (2020) finds mixing soccer players from different religious backgrounds improves cohesion within the soccer team but does not affect behaviors in other social contexts beyond the intervention. Dahl et al. (2021) finds that although exposure to women in traditionally male-dominated military squads leads men to choose occupations with a higher fraction of women immediately after the exposure, these effects are not persistent once the exposure ends.

[4]For example, the interventions include providing professional training (Groh et al., 2016; Ashraf et al.,

with strong conservative norms, we examine how an empowerment policy generates spillovers on gender norms through social networks and potentially widens the disparity between different groups of women based on their access to the network.

Lastly, our paper enriches the discussion on the transformation of China in the early 20th century. The existing literature has explored several drivers of the economic and political modernization of China, including openness to the West (Brandt et al., 2014; Jia, 2014; Levine et al., 2023), diffusion of ideology(Kung and Wang, 2020; Li, 2022; Bai et al., 2024), and modern industries and infrastructure (Lin et al., 2021; Kung, 2022; Bo et al., 2023). In particular, some recent work focuses on the formation of modern human capital, highlighting the important role of traditional social norms (Xue, 2023; Ma, 2024), foreign missionaries (Bai and Kung, 2015; Ma et al., 2022), and reforms to educational systems (Bai, 2019; Wang and Zhang, 2020). We enrich the discussion by examining the impact of the country's first university coeducation reform on women's educational attainment and gender attitudes toward female education. We highlight a novel perspective on the role of elite social networks in the formation of upper-tail human capital and the evolution of gender norms during China's modernization.

The rest of this paper is organized as follows. Section 2 presents an overview of the PKU coeducation reform and its spillover effects. Section 3 describes the data and the variables used in our analysis. Section 4 discusses the empirical strategy. Section 5 provides the main results of the effects of coeducation reform exposure on female higher education. Section 6 analyzes two mechanisms that explain the positive spillover on women's human capital accumulation. Section 7 discusses the limitations of elites by showing a null effect on the mass education of girls. Section 8 concludes.

2 Historical Background

In this section, we introduce the historical context. We first describe the coeducation reform at PKU in 1920 against the background of women's educational history in China. We then discuss its spillover effects on female human capital through male students, as documented in historical anecdotes.

2020; Bandiera et al., 2020), increasing financial control (Attanasio and Lechene, 2014; Almås et al., 2018), increasing participation in male-dominated fields (Dahl et al., 2021), and having female role models (Lafortune et al., 2018; Porter and Serra, 2020).

2.1 PKU Coeducation Reform in 1920

Throughout the history of China, both traditional Confucian norms and education institutes long excluded women from formal education (Chu, 1967; Whyte, 1996; Bailey, 2007).[5] Changes emerged from the 1840s when China's increasing connections with the Western world facilitated the spread of modern knowledge and ideology (Lei et al., 1993; Jia, 2014; Bai and Kung, 2015). Both Chinese reformists and foreign missionaries began to open nurseries and schools for girls to provide them with basic education (Lu, 1974; Yao and Luo, 2000; Zhang, 2007). And girls' primary and secondary schools became officially approved in 1907 (Lu, 1983; Lei et al., 1993).

However, the development of female higher education during that period was neglected. After the establishment of the first modern university in 1895, for over twenty years, Chinese universities did not admit women (Wong, 1995). As Appendix Table A.1 shows, until the late 1910s, there were no female students in any Chinese universities.[6] Debates on admitting female students into universities emerged during the New Culture Movement in the 1910s (Wong, 1995; Bailey, 2007). Challenging Confucianism traditions, this progressive movement placed the liberation and empowerment of women at the center of its agenda (Furth, 1983; Wong, 1995; De Bary and Lufrano, 2001; Chen, 2017). This environment paved the way for an unprecedented coeducation reform at PKU (Lei et al., 1993).

[5]The gender division of labor under the Confucian doctrines constrained women's participation in non-domestic activities (Whyte, 1996; Ebrey, 2003). Hence, the main purpose of educating women was to regulate their behaviors to obey Confucian moral disciplines and become qualified mothers and wives (Rosenlee, 2012, 2023). Meanwhile, education in imperial China mainly focused on preparing individuals for the civil service exam (Fairbank and Liu, 1980; Elman, 2000), from which women were excluded (Chu, 1967; Bailey, 2007).

[6]The only exceptions were three girls' colleges established by Protestant missionaries. They were Hwa Nan College (founded in 1914, Fuzhou), Ginling College (founded in 1915, Nanjing), and North China Union Women's College (founded in 1916, Beijing). Our paper does not consider them as universities before 1920 for several reasons. First, during the 1910s, the education provided in these colleges was mostly between secondary and tertiary education, corresponding to college preparatory level (Hu, 1919; Lutz, 1971). They were thus not widely considered as higher education institutes by the Chinese society. Moreover, they were not recognized as higher education institutes by the Chinese government until the late 1920s (Zhang, 2007). Second, the education provided in these colleges, especially in their early stage, integrated Christian doctrines and gender-specific courses like home economics (Hwa Nan College, 1932; Yao and Luo, 2000; Zhang, 2007). This feature made these colleges hardly convey a gender-equal message that women were capable to receive the same kind of higher education as men, which made the potential effect of these colleges on women's education decision fundamentally different from the coeducational university we are going to analyze. Last, these colleges had very small cohort size in the late 1910s, which, along with their strong religious background, limited their social impact and broader acceptance in Chinese society (Yeh, 2000; Kung, 2022; Mattingly and Chen, 2022).

Despite the widespread discourse on gender equality in education, it remained uncertain which university would pioneer coeducation and when this would happen. In early 1920, Cai Yuanpei, the president of PKU and a firm supporter of the New Culture Movement, announced in a public speech that PKU would admit female students to promote gender equality in China's higher education (Cai, 1934). Inspired by this announcement, some female students applied for auditing positions at PKU, with several gaining acceptance (Chinese Education, 1920).[7] In February, PKU reported that it had enrolled nine female audit students and confirmed that the university would officially admit female students from the 1920-1921 academic year onwards (Peking University, 1920).

This event is widely considered the beginning of female higher education in China, marking the first time that female and male students were granted equal right to receive education in the country's higher education institutes (Wong, 1995; Zhang, 2007).[8] Following PKU, Chinese universities gradually started to admit female students in the 1920s and 1930s (Wong, 1995). The number of female university students increased from 0 in 1917 to 431 in 1923, and 5,358 in 1933 (Ministry of Education, 1917; CEII, 1923; Ministry of Education, 1936).

[7]PKU conducted its entrance exams annually during the summer (Wang and Guo, 2000). When these female students applied, the admission process for the 1919 entry had closed, and the admission for the 1920 entry had not yet commenced. Consequently, they could only apply for an auditing position. The nine female students who successfully obtained the auditing position became officially registered students in the 1920-1921 academic year (Wang and Guo, 2000).

[8]Before the PKU coeducation reform, it has been mentioned in a few studies that Lingnan University had admitted female students from 1918 (Chen and Yuan, 2008). However, we do not consider this college as the first coeducational university for following reasons. First, PKU has been widely considered the first Chinese university to permit coeducation, by both mainstream historian works (for example, Lu, 1983; Lei et al., 1993; Bailey, 2007; Zhang, 2007), and, more importantly, the Chinese people and society at that time (for example, Hu, 1919; Chinese Education, 1920; Xu, 1920; Zhou, 1920; Liu, 1923). We believe that the key factor is how the coeducation reform was perceived by people in 1920, as these perceptions were crucial in shaping societal attitudes and behaviors. Second, Lingnan University was established by Protestant missionaries. Like other religious universities in China, the emphasis on Christians doctrines, the religious background, and the small cohort size compared to public and private universities, limited its impact on the Chinese society (Yeh, 2000; Zhang, 2007; Kung, 2022). Third, from an empirical perspective, even Lingnan University has been recognized as the first Chinese university that turned coeducation, we are not able to find most students records of Lingnan University and cannot conduct any empirical analysis. Since the university's catchment area was restricted to Guangdong province (Chen and Yuan, 2008), the analysis would also lack nationwide representativeness.

2.2 Spillovers of the PKU Coeducation Reform

Although only nine female students were admitted in February 1920, historical narratives suggest that the coeducation reform had much larger impacts that went beyond these female students. Male students on campus were among the first to be affected by the reform, as they had many opportunities to interact with female students in lectures, study groups, and student organizations (Xu, 1920). They shared their experiences with each other of engaging with female peers and had heated discussions about women's educational rights (Xu, 1920; Wang, 1920; Lei et al., 1993).

The presence of female students on campus induced more progressive attitudes toward female education among male PKU students (Zhang, 2007). Facing criticisms outside the university,[9] these male students shared their experiences and expressed support for female higher education. For example, Wang Zizhi, a male student in the Class of 1920, established a periodical named *Xin Long* (*New Gansu*) in the spring of 1920 that aimed to reform the traditional education system in his home province, Gansu. He also wrote an article in the periodical that advocated for providing equal higher education opportunities to women in Gansu (Wang, 1920).

More importantly, male students spread progressive gender norms through their social networks and inspired more women to pursue higher education. In the early 1920s, social networks played a dominant role in linking large cities to broader regions, since newspapers and railways had limited penetration into rural and remote areas (Kung, 2022). Anecdotal evidence shows that, among the female students who applied to universities later on, a number of them were female friends and relatives of male PKU students exposed to the coeducation reform. An illustrative example is Wang Lan, a female student admitted to PKU in 1920. After she dropped out of secondary school, her younger brother, who was studying at PKU, wrote to her about the new thoughts on women's liberation and empowerment he developed there. Influenced by her brother, she gradually abandoned the traditional gender norms that had bound her life and decided to pursue higher education (Xu, 1920).[10]

While historians have qualitatively discussed the spillovers of PKU coeducation re-

[9] For example, the reform received warnings from the Ministry of Education and criticism from the conservatives (Ministry of Education, 1920; Liu, 1923; Zhang, 2007).

[10] Appendix B provides more anecdotes, highlighting the importance of elite social networks of male PKU graduates with coeducation experience.

form on female education, there lacks empirical analysis to identify the causal relationship between indirect exposure to coeducation reform and women's educational decision, as well as the underlying mechanisms. Leveraging the reform's unexpected timing, we empirically explore its spillover effects on female educational outcomes and the potential mechanisms highlighted in historical narratives.

3 Data

We compile county-level panel data to analyze the impact of the PKU coeducation reform on female higher education outcomes and the evolution of gender norms.[11]

3.1 Data on University Students

We construct a comprehensive novel dataset of Chinese university students in the late Qing period (1872-1911) and the Republican period (1912-1949) from a large number of primary sources. Our main sources are four compilations of historical archives in Chinese universities, including the *Compilation of Modern China Alumni Records* (Wang, 2013) and volumes 1 to 3 of the *Collection of the Historical Documents on Higher Education of the Republican Period* (Li, 2014, 2016, 2017). We further complement our data with historical archives sourced from the Modern Documents Digital Platform of the National Library of China. Together, we digitize 183 registration records, alumni directories, and graduation yearbooks of 61 Chinese higher education institutes that were published in the late Qing dynasty and the Republican period.

Our dataset includes 81,607 student records from 36 of 40 universities and 20 of 39 colleges admitted between 1892 and 1936,[12][13] including 6,639 female students. For each record, we construct a short biography on the educational experience of the student, including the student's name, hometown, gender, major, level of study, university, and duration of study. For each record, we link the hometown to county, which is the

[11] County is the third and smallest administrative division in China after provinces and prefectures.

[12] We restrict our empirical analysis to the period before the Second Sino-Japanese War (1937-1945), as the Japanese invasion resulted in heavy civilian casualties and massive migration.

[13] The classification of universities and colleges is based on the classification of the Ministry of Education in 1933 (Ministry of Education, 1936). For simplicity, we will use the term "universities" to denote these higher education institutes.

third and most disaggregated level of administrative division in China. To avoid inconsistency due to changes in county boundaries, we use the map of China's county divisions in 1911 provided by Harvard CHGIS.[14]

In the absence of census data on educational attainment or systematic educational surveys in this period, our data are not able to cover the universe of university students. However, official statistics on the annual number of university graduates indicate that, by 1940, a total of 114,572 students had graduated from China's higher education institutes (Ministry of Education, 1942). This number corresponds mostly to those admitted up to 1936. Even after accounting for students on leave or who dropped out, as well as the widespread disruptions caused by the outbreak of the Second Sino-Japanese War in 1937 affecting students supposed to graduate between 1937 and 1940, our dataset remains a representative sample that encompasses about two-thirds of the students in Chinese universities during this period.

3.2 Exposure to the Coeducation Reform

Our paper focuses on the indirect effect of the coeducation reform, which was spread by the male graduates of PKU with coeducation experience. Hence, the key explanatory variable is a dummy for whether a county had male PKU graduates who experienced the coeducation reform during their study at PKU.

From the university student dataset described in Section 3.1, we obtain the full list of PKU graduates between 1898 and 1948.[15] Using information on each graduate's home county and year of graduation, we aggregate individuals at the county level to compute whether a county has male PKU graduates in each year. In baseline estimation, we define counties having male students who graduated in 1920 as treatment counties, while those not having male graduates in 1920 but having male graduates in 1919 as control counties. Figure 1 depicts the geographic distribution of treatment and control counties. Our baseline sample has 323 counties, with 184 counties having male PKU

[14] 1911 was the end of the Qing dynasty's governance, while 1912 was the start of the Republic of China (Republican period) (1912-1949). The Republican period was widely known for its weak state capacity, warlord conflicts, and unstable governance, which led to frequent changes in administrative divisions and incomplete records (Sheridan, 1983). Therefore, we regard the map of county divisions in 1911, which provides the most reliable information on China's county divisions in a period that is close to the historical event we study.

[15] This data is initially compiled by the *Alumni List of Peking University: 1898-1948* (Peking University Alumni Association, 1948).

students who graduated in 1919, and 255 counties having male PKU students who graduated in 1920. Among these counties, 116 counties had male PKU graduates both in 1919 and 1920. In our baseline estimation, we consider them as treatment counties. We conduct robustness checks in Section 5.6.

[Figure 1 should be here]

3.3 Female Higher Education

Our main outcome of interest is female enrollment in universities, which reflected the spillover on the gender norms toward female higher education. Based on our university student dataset, we have the profiles of 6,639 female students admitted to Chinese universities between 1920 and 1936.[16] We identify the home counties of these female students based on hometown information using a similar approach as in Section 3.2. We then aggregate the total number of female students who attended Chinese universities by year between 1920 and 1936 and construct a county-year panel dataset. Figure 2 illustrates the geographic distribution of the number of female students who registered in Chinese universities between 1920 and 1936 in our treatment and control counties. The deeper shade of blue in the map shows that treatment counties had more female university students than control counties in this period.

[Figure 2 should be here]

3.4 Control Variables

To increase the precision of our estimation, we control for a rich set of geographic and social characteristics of counties, although Section 4.1 will show that the treatment and control counties are comparable in these characteristics. Regarding the geographic characteristics, we include a county's area, slope, ruggedness, rainfall, temperature, and land quality for agriculture. We also account for a county's location using its distances to major rivers, to the coast, to provincial capitals, and to treaty ports, as literature suggests that these features would affect a county's industrialization and modernization (Jia, 2014).

[16] As discussed in Section 2.1, Chinese universities did not admit female students before 1920, so by construction, our data cannot extend before the PKU coeducation reform in 1920.

As suggested by the literature, we control for social characteristics that could affect female educational outcomes in the early 20th century. We first control for economic prosperity using pre-1920 population density and the number of modern firms and banks (Kung, 2022). To account for the influence of traditional education and Confucianism (Bai and Jia, 2016; Chen et al., 2020), we include two characteristics related to *Keju*, the traditional civil-service examination system of imperial China — the number of *Jinshi* and *Shengyuan* quotas. *Jinshi* were the candidates who succeeded in the highest level of the imperial civil service exam, while the *Shengyuan* quota was the number of eligible candidates at the entry-level exam allocated by the central government (Chang, 1955; Bai and Jia, 2016). Last, we use the number of Christians to measure the influence of Christianity, which affected the development of modern education and economic prosperity (Bai and Kung, 2015; Ma et al., 2022). All social characteristics, except for population density, are normalized by pre-1920 population to account for the heterogeneity of county sizes. The sources of these control variables are listed in Table 1.

3.5 Sample Selection

Based on the county divisions of China in 1911, we merge all data at the county level to empirically test for a causal effect of PKU coeducation reform exposure on female higher education outcomes. We make several restrictions to our baseline sample. First, we restrict to the 18 provinces where Han Chinese are the majority and exclude regions that were controlled by foreign countries.[17] Second, considering that counties where provincial governments were located could have unparalleled political importance and usually enjoyed geographical and informational advantages, we exclude provincial capitals from our baseline estimation (Bai and Jia, 2023).[18]

Table 1 presents descriptive statistics for the variables used in our baseline analysis. The mean value for the female university student dummy is 0.067, indicating the probability of a county having female students admitted to university in a year is 6.7%.

[17]Based on provincial division in 1911, our dataset includes Zhili, Shandong, Shanxi, Henan, Jiangsu, Anhui, Jiangxi, Fujian, Zhejiang, Hubei, Hunan, Shaanxi, Gansu, Sichuan, Guangdong, Guangxi, Yunan, and Guizhou. We exclude the frontier provinces of Xinjiang, Tibet, Mongolia, and Qinghai. We also exclude Manchuria (Fengtian, Jilin, Heilongjiang) and Taiwan, which were colonized or predominantly occupied by foreign powers in the early 20th century.

[18]We conduct robustness checks that include provincial capitals in Section 5.6.2.

The small number confirms the claims in historical work that higher education in early 20th century China was accessible only to a small elite portion of the population (Li et al., 2004; Ren et al., 2020; Zhang et al., 2023).

[Table 1 should be here]

4 Empirical Strategy

We examine the impact of the coeducation reform using the following quasi-experimental specification:

$$Y_{ipt} = \beta \textit{PKU Graduate}\ 1920_{ip} + X'_{ipt}\gamma + \lambda_p \times \theta_t + \epsilon_{ipt} \tag{1}$$

where Y_{ipt} is the measure of female education outcomes in county i of province p in year t, with t ranging from 1920 to 1936. *PKU Graduate* 1920_{ip} is a dummy that equals one if county i is the home county of a male PKU student who graduated in 1920, and zero if county i does not have male PKU graduate in 1920, but is the home county of a male PKU student who graduated in 1919. By construction, only counties with male PKU graduates in either 1919 or 1920 enter our sample. In baseline estimation, *PKU Graduate* 1920_{ip} equals one if county i had male PKU graduates in both 1919 and 1920. In Section 5.6.2, we examine the robustness of this specification by excluding the counties that had male PKU graduates in both 1919 and 1920 from our sample. X_{ipt} contains the time trends of a vector of county-level control variables listed in Section 3.4, accounting for time-varying heterogeneity in geographic and social characteristics. $\mu_p \times \theta_t$ controls for province-year fixed effects that capture unobservable provincial heterogeneity that varies over time. ϵ_{ip} is the error term. Standard errors are clustered at the county level.

In baseline estimation, we are not able to conduct a difference-in-differences analysis using the exogenous timing of coeducation reform. This is because Chinese universities did not admit female students before the coeducation reform. According to the official statistics summarized in Appendix Table A.1, as of 1917—the closest year to the reform with available data—there were no female students enrolled in Chinese universities (Ministry of Education, 1917). Therefore, our empirical setup lacks pre-treatment

period which is required for a difference-in-differences analysis.

4.1 Identifying Assumptions

Our causal interpretation of the results from quasi-experimental estimation relies on two key identifying assumptions: non-anticipation of the coeducation reform and parallel trends. The non-anticipation of the coeducation reform assumes that male PKU students did not change their behavior and graduation decisions in anticipation of the coeducation reform. The parallel trends assumption requires that, the trends in female education outcomes in treatment and control counties would be the same in the absence of the coeducation reform exposure in the post-reform period after controlling for county-level characteristics and province-year fixed effects.

A violation of the non-anticipation assumption would imply that the change in the university culture can explain both the timing of the reform and the differences between male graduates in 1919 and 1920, and hence the female educational outcomes in their home counties. The unexpected timing of the reform in 1920 provides an ideal quasi experiment. As discussed in Section 2.1, PKU declared China's first coeducation reform in higher education in early 1920 and the exact timing of the reform was unanticipated by the students. As a result, male PKU students who graduated in 1920 had the experience of coeducation, while those who graduated in 1919 did not. Since both cohorts were admitted before the reform, they did not compete with women during application, and their expected probability of experiencing coeducation reform was the same *ex ante*. They became an ideal pair of treatment and control cohorts in our empirical setting.

The parallel trends assumption focuses on the comparability between treatment and control counties. As a result of the unexpected timing of the reform, the allocation of treatment and control counties should be irrelevant to any factors that simultaneously affect the exposure to coeducation reform and female students' decisions of attending universities. Due to the lack of pre-reform observations on female higher education outcomes, we are not able to examine the parallel pre-trends in our baseline estimation. Instead, we conduct balance checks in Table 2 on counties' geographic and socioeconomic characteristics. We report the mean values conditional on provin-

cial fixed effects, which do not show any statistically significant differences between treatment and control counties.

[Table 2 should be here]

4.2 Comparability at the Individual Level

Another concern in causal identification is the comparability of treatment and control cohorts. Although we have shown balance at the county level, there exists the possibility that the male students in the treatment and control cohorts were systematically different and hence the effect on female education was not due to the experience of coeducation reform, but the specific features of the 1920 cohort. We address the potential imbalance between the two cohorts throught three individual-level balance checks.

First, the pre-reform characteristics between the 1919 and 1920 cohorts might be different. Hence, we examine the balance in the frequency of common surnames. If the 1920 cohort more likely originated from large clans compared to the 1919 cohort, it would be not surprising to observe more female students in the home counties of the 1920 cohort. Larger clans were more capable of providing public goods to support the education of female members (Greif and Tabellini, 2010, 2017; Alesina and Giuliano, 2014), even without the influence of coeducation reform. We choose eight surnames with the largest population share among Han Chinese, and Appendix Table A.2 shows that the treatment and control cohorts are balanced in their surnames.

Second, the experience at PKU before the coeducation reform might be different between the two cohorts. Specifically, major choices at PKU influenced male students' likelihood of directly interacting with female students after the reform. If the 1920 cohort had a larger proportion of students who were in the same departments as the first cohort of female students than the 1919 cohort, the increased direct interactions might introduce upward bias when estimating the effects on female education in treatment counties. Utilizing registration records, we collect the majors of male students who graduated in 1919 and 1920, and aggregate students' majors into broader categories at the school level.[19] Appendix Table A.3 confirms that the treatment and control cohorts

[19]The rationale for aggregating students' majors into broader categories is that department sizes were quite small in the early 1920s, and it was common for students within the same school to share a large proportion of courses, even if they were not in the same department (Yeh, 2000).

are balanced in their major choices.

Third, the treatment and control cohorts might experience different exposure to social movements that simultaneously affect their attitudes toward female education. If this were true, even if male students from the 1920 cohort spread more gender-equal attitudes to their home counties and inspired more female students to enter university, the positive effect could not be attributed solely to their exposure to the coeducation reform but to other historical events that prompted a progressive shift in their gender attitudes.. The New Cultural Movement and the May Fourth Movement, aiming at promoting progressive social changes, were the two most important and influential events of the 1910s (Grieder, 1970; Kenley, 2004).[20] If male students from the 1920 cohort were more influenced by either movement, they would be more likely to hold progressive views on female education, as women's liberation and empowerment were central themes in these movements (Chow, 1960; Bailey, 2007). In Appendix Table A.4, we exploit students' writings in periodicals about these two events, membership in progressive student groups, and arrest records during the student protests to measure their engagement in the two movements. The individual-level balance checks suggest limited evidence of significant differences in participation in either movement between the treatment and control cohorts.

5 Effects on Female Higher Education

5.1 Baseline Results

We start by establishing the causal impact of coeducation reform exposure on female higher education outcomes between 1920 and 1936. Table 3 presents the estimates of equation (1). As shown in Column (2), with a county's geographic and social characteristics and province-year fixed effects controlled for, a county's exposure to the experience of coeducation reform increased a county's probability of having female students admitted by Chinese universities in each year by 11.4 percentage points. This increase corresponds to an annual increase of 0.46 standard deviations. Considering

[20]The New Cultural Movement promoted cultural change to replace Confucian tradition with more progressive Western ideologies, and as a continuation of it in the political sphere (Chow, 1960), the May Fourth Movement is a momentous cultural and political movement arising from student protests in Beijing on May 4, 1919.

that the sample mean of the probability of women attending higher education is 6.71 percentage points in a country-year cell, the positive impact we find is substantial.

The positive effect remains robust when we use alternative measures of female higher education outcomes. In counties exposed to coeducation reform through male graduates, Column (4) shows that the total number of female university students being admitted increased by 11.64% each year, and Column (6) shows that the total number of female students admitted by Chinese universities per 1 million women increased by 35.04% each year.

[Table 3 should be here]

5.2 Potential Confounders

We have so far shown that the exposure to coeducation reform through male PKU graduates significantly increased a county's female higher education outcomes. In this section, we address potential confounders in order to rule out alternative explanations and demonstrate that the positive effect we observe can be causally interpreted as the impact of exposure to coeducation reform through male PKU graduates with coeducation experience.

First, the positive effect in the home counties of the 1920 cohort might be attributed to unobserved characteristics, specific to either cohorts or counties, that also affect women's education. The balance checks in Section 4 first show that there is no statistically significant difference between the two cohorts or their home counties across a rich set of characteristics. We further tackle this problem by using alternative treatment and control cohorts, which satisfy the same identifying assumptions while mitigating potential biases related to baseline cohorts or counties. As summarized in Appendix Table A.10, Panels A and B compare the baseline control counties with alternative treatment cohorts of 1921 and 1922, ruling out bias from using 1920 as the treatment cohort. Panels C and D compare the baseline treatment counties with alternative cohorts of 1918 and 1917, ruling out bias from using 1919 as the control cohort. Panels E and F simultaneously use alternative treatment and control groups graduated one and two years (before) after our baseline (control) treatment cohorts. We find similar effects in all settings, indicating that the baseline effect is unlikely to be driven by any spe-

cific characteristics of the home counties of 1919 or 1920 cohorts. By comparing the magnitudes of coeducation reform exposure, we find that the largest average effect is observed in our baseline specification. The positive spillover is most evident between the cohorts who graduated just before and after the reform, which are also the most similar cohorts with fewer impacts of other confounding factors. This finding further validates our baseline specification that uses the 1919 and 1920 cohorts.

The second concern is that the presence of male PKU graduates in 1920 might induce changes in counties beyond the experience and attitudes brought by them, which also affects women's educational decisions. We consider two factors that might drive the positive effects as well. First, counties with male graduates in 1920 may have stronger connections with Beijing during the same year, allowing the news of coeducation reform to spread more easily to these counties and change female educational outcomes, independent of the male graduates' personal efforts to disseminate the news of the reform and progressive gender norms. In Panel A of Appendix Table A.11, we include the number of telegraph stations and the distance to the railway. The results remain consistent, suggesting that the spread of information cannot fully explain the observed effects. Second, in line with baseline findings, treatment counties would have a larger number of female students enrolled in universities shortly after the reform, motivating more women to pursue higher education through channels like role model effects (Lafortune et al., 2018). The positive effect we observe would then stem from the direct effect of early female university students rather than the indirect effect through exposed male graduates. To distinguish these two channels, we control for the number of female students registered at PKU between 1920 and 1922 in Panel B of Appendix Table A.11. The results remain consistent with slightly reduced magnitudes, suggesting that early female university students cannot fully explain the observed positive effects.

Third, PKU coeducation reform might coincide with other larger historical events that affected the gender attitudes of the 1920 cohort and subsequently female education in their home counties. As described in Section 2.1, Chinese society in the late 1910s experienced rapid social change, marked by movements advocating for the liberation of women. Consequently, the observed positive effect may arise from more exposure to social movements of the 1920 cohorts instead of the experience of coeducation reform. However, this scenario is unlikely, as the individual balance check in

Section 4.2 shows there is no significant difference between the 1919 and 1920 cohorts in their participation in other contemporaneous progressive movements. Moreover, given that most influential social movements in the late 1910s were centered in Beijing (Chow, 1960),[21] we estimate equation (1) using the home counties of male graduates from other Beijing-based universities in 1919 and 1920, who were exposed to the same progressive movements and other important historical events that could change their gender attitudes as PKU graduates. Appendix Table A.12 shows that, in the lack of coeducation reform exposure, we do not find any positive effect on female higher education in the home counties of the 1920 cohorts of these universities.

Last, one may question whether PKU is an exceptional case, as certain specific features of PKU in 1920 rather than the coeducation reform might explain the positive spillover. One possibility could be that the coeducation reform reflected a broad transformation toward a progressive atmosphere at PKU that changed male students' gender attitudes.[22] To rule out this possibility, we collect information on the timing of other Chinese universities turning coeducational and conduct a staggered DID analysis by pooling all coeducation reforms together and estimating the following equation:

$$Y_{ipt} = \beta_1 \textit{Coed Graduate}_{ipt} + X'_{ipt}\gamma + \lambda_p \times \theta_t + \delta_i + \epsilon_{ipt} \tag{2}$$

where *Coed Graduate*$_{ipt}$ is a dummy that equals one if a county i has its first male graduate from any coeducational university in or before year t. As presented in Appendix Table A.12, we find a similar positive effect. Column (2) indicates that having a male student with coeducation experience increased a county's probability of having female university students by 7.72 percentage points, smaller than baseline effect in magnitude. In Appendix Figure A.3, we group universities by their year of turning coeducational and find that only for universities that turned to coeducation between 1920 and 1925, their male graduates had a significant positive effect on female education in their home counties. These results confirm that the positive spillovers of coeducation reform

[21] For example, the New Culture Movement and May Fourth Movement examined in Section 4.2 were both centered in Beijing (Chow, 1960).

[22] A number of active participants in the progressive social movements in the 1910s were faculties and students of PKU (Dirlik, 1985). For example, the key founders of the New Culture Movement, such as Chen Duxiu, Hu Shi, and Qian Xuantong, were all professors at PKU (Weston, 1998). In the May Fourth Movement, several famous students leaders, Duan Xipeng, Luo Jialun, Fu Sinian, Zhou Binglin, and Xu Deheng were all PKU students (Chow, 1960).

through male students are not driven by specific characteristics of PKU and highlight the importance of early exposure.

5.3 Dynamic Effects

In Section 5.1, we examine the average effect of PKU coeducation reform on female higher education outcomes between 1920 and 1936. To better capture the dynamic effects across years, we break down the effects by estimating equation (1) separately for each year between 1920 and 1936. Figure 4 presents the coefficients and their 95% confidence intervals of coeducation exposure. Both the significance and magnitude of the effect remain limited in the early 1920s. Since the mid-1920s, the magnitude of the positive effect on female higher education kept increasing and reached its peak in 1930.

[Figure 4 should be here]

The lagged effect on female university enrollment can be understood through both the supply and demand sides of higher education. First, we argue that the primary reason is the lagged supply of higher education opportunities for women. As shown in Figure A.4, the annual number of universities that transitioned to coeducation remained relatively small in the early 1920s, experiencing a drastic increase in the late 1920s, which substantially expanded opportunities for female students to pursue higher education.[23] This pattern is consistent with the dynamic effect we document in Figure 4. In Section 6.3.1, we will provide empirical evidence on how increased supply of coeducational universities affected a county's response to coeducation reform exposure.

Second, the demand for higher education could vary across years as well. The increasing magnitude suggests the positive effect might be more pronounced among the latter cohorts of girls, whose educational choices were shaped during their formative years by the coeducation reform. These girls were influenced when they were relatively young and flexible in their future plans and they reached the age to attend universities in the late 1920s.

Notably, by the 1930s, it is quite plausible that counties with 1919 graduates had already had new post-reform PKU graduates who shared the experiences of coeduca-

[23] It is worth mentioning that among these universities, only three were newly established women's universities, while the rest transformed from single-sex universities for men to coeducation.

tion back in their home counties. However, the impact of early coeducation exposure on female higher education did not diminish over a period of 15 years, indicating that the timing of exposure matters. In the next section, we will provide further discussion on the heterogeneity between earlier and later-exposed cohorts.

5.4 Importance of Reform Exposure

Our results show that exposure to coeducation reform in 1920 significantly improved female higher education outcomes in exposed counties, as evidenced by comparing the home counties of 1919 and 1920 male cohorts. However, the later cohorts graduating after 1920 had the same coeducation experience as the 1920 cohort, and in this section, we analyze whether the later cohorts could generate similar positive spillovers on female higher education in their home counties.

Exploiting the emerging literature on heterogeneous treatment effects in the two-way fixed effect estimation (De Chaisemartin and d'Haultfoeuille, 2020; Callaway and Sant'Anna, 2021; Sun and Abraham, 2021), we conduct a staggered difference-in-differences analysis to account for exposure to PKU coeducation reform after 1920:

$$Y_{ipt} = \beta \textit{PKU Graduate}_{ipt} + X'_{ipt}\gamma + \lambda_p \times \theta_t + \delta_i + \epsilon_{ipt} \tag{3}$$

where we restrict our sample to counties with male PKU graduates between 1898 and 1948 and construct a county-year panel spanning from 1919 to 1936. The inclusion of 1919 is for the completeness of the estimation, allowing us to obtain the coefficient for counties being treated in 1920. Given that Chinese universities did not admit female students prior to 1920, the outcome variables are recorded as zero for all counties in the year 1919. $\textit{PKU Graduate}_{ipt}$ is a dummy that equals 1 once county i had at least one male PKU graduate with coeducation experience (graduated between 1920 and 1936) by year t, and 0 otherwise. Here we consider using the not-yet-treated counties as control groups, referring to counties that had male graduates between 1920 and 1936 but did not have them yet by year t. δ_i are county fixed effects. Y_{ipt}, X_{ipt} and $\lambda_p \times \theta_t$ are defined as in equation (1).

As shown in Table 4, our estimation reveals a positive spillover of coeducation exposure at PKU in the home counties of male graduates, when pooling the average treat-

ment effects of all cohorts between 1920 and 1936 together. This finding remains robust when using never-treated counties as control groups in Appendix Table A.14.[24] The coefficient is larger than our baseline estimation, suggesting that later-treated cohorts might contribute to a positive spillover in their home counties as well.

[Table 4 should be here]

To disentangle the heterogeneity between early and later treatment, we plot the average treatment effect for each cohort in Figure 5. The result indicates that the significant positive spillover from coeducation experience is predominately observed in the early-treated cohorts of 1920, 1921, and 1922. We argue that the disparity in spillover effect between early and later cohorts primarily stems from the different coeducation experiences across cohorts. The cohorts who graduated from 1920 to 1922 not only exposed to female students on campus but also, experienced the transition from single-gender education to coeducation during their time at PKU. This finding reveals the dynamics in the effect of exposure to women in male-dominating fields, emphasizing the importance of the initial entry of women in shaping the attitudes and behaviors of men (Greenberg et al., 2024; Shan, 2024). Additionally, for later-treated cohorts, the coeducation at PKU might no longer be perceived as a novel experience worth sharing with people in their home counties. Even if their attitudes toward female education changed similarly to those of the early-treated cohorts, the decreased likelihood of sharing these experiences and gender norms would have limited their spillover effects on female education.

[Figure 5 should be here]

Meanwhile, Appendix Figure A.4 shows there were around 15 universities admitting female students by 1925, and Section 5.2 indicates a similar positive spillover of the follow-up universities. Consequently, in the staggered DID framework, it is possible that both later-treated counties and not-yet-treated counties had male graduates of other coeducational universities. This treatment from other universities undermines the potential impact that the later PKU cohorts could have on promoting female education in their home counties.

[24] Here, the never-treated counties refer to counties that had male PKU graduates before 1920 or after 1936 but did not have any male graduates between 1920 and 1936.

5.5 Event Study

In this section, we further validate our causal interpretation of the impact of coeducation reform exposure on female higher education using data on female Chinese students studying abroad to directly examine the parallel pre-trend assumption.[25] Due to the limited number of universities open to women and restrictive gender norms, studying abroad was an important alternative option for Chinese women seeking higher education (Lei et al., 1993). Specifically, Japanese universities began to admit female students in the early 1900s and were the most attractive destinations for Chinese students owing to Japan's cultural similarities and geographic proximity (Fujimura-Fanselow and Kameda, 1995; Zhou, 2007).

We collect profiles of female Chinese students studying in Japanese universities between 1900 and 1936 from Zhou (2007), and construct a county-year panel dataset on female Chinese students in Japanese universities before and after the coeducation reform. We first perform an event study to provide evidence on the parallel trends assumption, which requires that, in the absence of coeducation reform exposure in 1920, the female higher education outcomes in the home counties of male PKU students who graduated in 1920 and 1919 would have followed similar trends over time. The event-study framework is defined as follows:

$$Y_{ipt} = \sum_{t=1915, t\neq 1919}^{1936} \beta_t PKU\ Graduate\ 1920_{ip} \times Year_t + X'_{ipt}\gamma + \mu_i + \lambda_p \times \theta_t + \epsilon_{ipt} \qquad (4)$$

where $Year_t$ is a dummy variable that equals one in year t, and the reference year is 1919.[26] Y_{ipt} is the outcome variable of female university students in Japan for county i in province p and in year t. μ_i denotes county and year fixed effects. The rest of the variables are defined as in equation (1). We cluster standard errors at the county level. Figure 6 depicts the coefficients on $PKU\ Graduate\ 1920_{ip} \times Year_t$ and their 95% confidence intervals. The insignificant coefficients in the pre-reform periods support

[25] As discussed in Section 4, we are not able to directly examine the parallel pre-trend in female higher education between treatment and control counties due to the fact that Chinese universities did not admit female students before 1920.

[26] Our event study is restricted to the period between 1915 and 1936 for two reasons. First, the number female students in Japan before 1915 was limited, making the estimation noisy and unstable. Second, this approach excludes the period of the Qing dynasty and the first three years after the collapse of the Qing Empire, a stage of political turmoil when the unstable environment often led to abnormal decisions in education (Zhou, 2007).

the parallel trends assumption for causal identification.[27]

[Figure 6 should be here]

Figure 6 presents a different dynamic pattern from the lagged effect observed in the baseline estimation in Figure 4, showing a prompt increase in female Chinese students in Japan shortly after the coeducation reform, followed by decreasing magnitude and significance from the mid-1920s. This immediate response is likely due to the limited availability of Chinese universities admitting women, particularly in the early 1920s, as suggested in Appendix Figure A.4. In contrast, universities in Japan had already been admitting female students, making overseas study a more accessible and immediate option for female students seeking higher education in response to the reform.

Considering the potential substitution between Chinese and Japanese universities, we estimate equation (4) using combined data on female Chinese students in both countries. Appendix Figure A.5 shows a similar pattern to Figure 4, where the pattern of female students in Chinese universities dominates. This pattern is not surprising, as compared with female students studying Chinese universities, the number of women studying in Japan only comprise 5% in our sample.[28] Moreover, this finding confirms that the positive effect observed in the baseline analysis is not merely a compositional shift of female students from Japanese to Chinese universities, but rather reflects an overall improvement in female human capital accumulation.

We also conduct a standard DID estimation and present the results in Appendix Table A.15. Column (2) indicates that exposure to coeducation reform increased a county's probability of having female students admitted to Japanese universities by 2.07 percentage points per year. This finding suggests that the positive effect of coeducation reform exposure not only motivated female students to attend Chinese universities, but also increased the demand for higher education abroad, although with a smaller magnitude.

[27] We also conduct a formal sensitivity analysis following the method developed by Rambachan and Roth (2023). The analysis provides a "breakdown value" $\bar{M} \approx 1.05 > 1$, indicating that the significant post-treatment effect remains robust even when allowing for violations of the parallel trends assumption that exceed the maximum deviation observed in the pre-treatment period. This analysis provides formal evidence that the pre-reform periods uphold the parallel trends assumption.

[28] In our dataset, there are 6,639 female students in Chinese universities between 1920 and 1936, and 388 female students in Japanese universities between 1920 and 1936.

5.6 Robustness Checks

We perform a series of robustness checks to examine whether our findings are sensitive to alternative definitions of variables or model specifications. Figure 3 summarizes the estimates of these robustness checks and compares them with the baseline effect.

[Figure 3 should be here]

5.6.1 Alternative Definitions

First, we show our results remain consistent with alternative definitions of dependent and independent variables. In Panel A of Appendix Table A.5, we replace the dummy variable indicating the existence of male graduates in 1920 with the total number of male graduates in 1920 as the key independent variable. In Panel B, we use Inverse Hyperbolic Sine (IHS) transformation for continuous outcome variables as an alternative method to reduce the influence of outliers in the right-skewed distribution of female university students. The results remain robust when using alternative definitions of key variables.

5.6.2 Alternative Specifications

Next, we show the consistency with alternative specifications. Appendix Table A.6 summarizes the results. Panel A controls for prefecture-by-year fixed effects rather than province-by-year fixed effects to account for regional heterogeneity with a lower level of aggregation.[29] We then examine the robustness on the selection of sample. In Panel B, we exclude the "overlapping" counties that had male PKU graduates in both 1919 and 1920 from our sample. These counties are considered as treatment counties in our baseline estimation. However, having PKU graduates in both years may suggest the county had better educational quality that facilitated human capital accumulation, which would bias the outcome variable upwards. In Panel C, we include provincial

[29] Prefecture is the second administrative level between provinces (first level) and counties (third level) during the period studied in this paper. However, prefecture as a level of administrative division was abolished in 1928 and the remaining levels of administrative divisions in China only consisted of province and county until the collapse of the Republic of China in mainland China in 1949 (Fu and Zheng, 2007). Hence, we consider it more sensible to control for province fixed effects in our baseline specification.

capitals, which are excluded in baseline sample to avoid the bias from better educational quality and higher levels of economic development. The results in both panels show that the positive spillovers are not mainly driven by more developed counties.

In Panel D and E, we deal with correlation in standard errors. Panel D clusters standard errors at the province-by-year level. Compared with clustering at the county level in baseline specification, this test accounts for the autocorrelation at a more aggregated level. And Panel E applies Conley standard errors to account for geographic correlation in standard errors (Conley, 1999).

Our baseline analysis suffers from a loss in sample size when including geographic and social controls, which is mainly due to missing data in the population census. Panel F restricts our analysis to the counties where we have data on all control variables, to rule out the possibility that our results are driven by selectively missing data on certain control variables.

Last, we tackle the problems of estimation method. Our main outcome is a dummy variable indicating whether a county had female students admitted to universities in a given year, where OLS estimation would raise concerns about non-linearity in estimation with binary outcomes. The other two outcomes are the total number and the number per million of female students admitted to universities, both with a logarithmic transformation applied. Given the small size of female university students, a notable proportion of observations are zero. To better address the non-linearity and censoring at zero in our estimations, we use Probit and Tobit models to estimate equation (1) for different outcome variables, respectively. The results estimated by generalized linear models are reported in Panel F. In summary, all the robustness checks in Appendix Table A.6 confirm that our baseline results are not sensitive to alternative specifications and sample selections.

5.6.3 Placebo Tests

In this section, we perform three sets of placebo tests to examine whether our finding is driven by randomness. We first conduct three randomization tests to assign placebo treatment and control counties in different samples. First, within our baseline sample, we randomly assign each county as either treatment or control county. Second, we expand to a full sample of counties included in our dataset and randomly assign each

county as either treatment or control. Third, we perform a two-step randomization in the full sample by randomly assigning whether a county had male graduates in 1920 and 1919 separately. In this scenario, counties with male graduates in 1920 are defined as treated counties, and counties without male graduates in 1920 but with male graduates in 1919 are defined as control counties. The distributions of coefficients are plotted in Appendix Figure A.1, with the red vertical line indicating our baseline effect. The true effect is far larger than the placebo effect and the distributions of placebo coefficients have a mean at zero, indicating zero effect in randomization tests on average.

In the second placebo test, our hypothesis is that, when comparing two cohorts, both of which did (or did not) experience coeducation, we should not find an effect as large as the true effect. We replicate our baseline analysis by randomly choosing two cohorts from 1909-1919 or 1920-1936 and assigning one of them as the treated cohort and the other as the control cohort.[30] We estimate equation (1) with all 382 possible combinations of placebo treatment and control cohorts and plot the distribution of coefficients and t-statistics in Appendix Figure A.2. In subfigure (b), we show the scatter plot of each coefficient and t-statistic combination, with the red lines indicating the true effect and t-statistics as well as their opposite numbers. This graph enables us to compare the absolute magnitudes between the placebo effects and true effects. We do not find any of the placebo treatment—control combinations generate an effect as large as our true effect in both coefficient magnitudes and significance levels.

The last placebo test we develop is to use male university enrollment as the outcome variable. We argue that the coeducation reform should only generate positive spillovers on female higher education, without affecting the educational outcomes of male students. From our university students database, we compile county-level panel data on male university students between 1892 and 1936. With pre-reform data on male students, we perform a difference-in-differences analysis in Appendix Table A.7. The insignificant results for male students reveal that only women's university enrollment benefited from the coeducation reform. The positive effects on female higher education could not be explained by an overall improvement in human capital accumulation

[30] Although Peking University was established 1898, the operation of the university was disrupted by the Boxer Rebellion in 1900 and did not resume until the December of 1902 (Wang and Guo, 1993). The first cohort of undergraduates were graduated in 1909 (Peking University Alumni Association, 1948; Wang and Guo, 1993).

in the exposed counties. Meanwhile, the insignificantly positive coefficient indicates that introducing women to universities did not crowd out male students.

5.6.4 Selection on Observables

This section provides two additional checks on the causal identification of baseline estimation by addressing selection on observables with matching methods.

We match counties with male PKU graduates in 1919 and in 1920, using matching covariates that include all county-level geographic and social controls we use in equation (1). Appendix Table A.8 presents the average treatment effect (ATE) and the average treatment effect on the treatment (ATT) estimated by both propensity score matching and neatest neighbor matching. We then estimate equation (1) using the matched sample. In Appendix Table A.9, the regression is weighted by the propensity score in Panel A, and we control for nearest neighbor matched-pair fixed effects in Panel B. Our matching exercises suggest that selection on pre-reform characteristics is unlikely to be a considerable threat to our causal identification.

6 Explaining the Positive Spillover on Female Elites

What explains the positive effects of coeducation reform on female higher education in the home counties of exposed male students? In this section, we provide two mechanisms to understand the positive spillover: (i) male students' gender attitudes, and (ii) elite social networks.

6.1 Male Students' Progressive Gender Attitudes

We first study whether the exposed male students possessed more gender-equal attitudes toward female education after the coeducation experience. Dating back to the early works of Williams Jr (1947) and Allport et al. (1954), extensive research has examined the effects of exposure to out-group members on reducing intergroup tension and prejudice. More recent economic literature provides empirical evidence showing that exposure to diversity shapes individual attitudes and social behavior (for example, Carrell et al., 2019; Rao, 2019; Mousa, 2020; Billings et al., 2021; Lowe, 2021; Bursztyn

et al., 2024). Hence, we argue that male students were not merely channels for spreading information about and experiences from the coeducation reform, but that their attitudes toward female education shifted first, driving positive changes in their home counties.

In the absence of time-varying data to directly track the evolution of male students' attitudes, we provide suggestive evidence on the impacts of the coeducation reform on male students' gender attitudes toward female education by comparing three proxies between exposed and non-exposed male cohorts post-reform. We collected personal profiles for 224 out of the 903 male PKU students who graduated in 1919 and 1920 from multiple sources.[31] We construct three dummy proxies for individual attitudes on female education: (i) whether the male student supported female education through writing articles or participating in public activities after the coeducation reform;[32] (ii) whether the male student chose to marry a woman with college education; (iii) whether the male student chose to teach in a girls' school or coeducational school after his graduation.

Appendix Figure A.6 shows the mean values of three dummy proxies for the treatment (1920) and control (1919) cohorts. The treatment cohort, who experienced coeducation reform during their study at PKU, exhibited a higher probability of holding more progressive attitudes toward female education. For instance, within male graduates with accessible personal profiles, around 5% of the 1919 cohort showed their support for female education after the reform, compared to over 25% for the 1920 cohort. We further confirm these descriptive patterns by estimating the following equation:

$$Y_{ip} = \beta \textit{Graduate}\ 1920_{ip} + \lambda_p + \epsilon_{ip} \tag{5}$$

where Y_{ip} is the proxy for individual attitudes on female education of male PKU student i from province p, *Graduate* 1920_{ip} is a dummy variable equal to 1 if the student graduated in 1920 and 0 if he graduated in 1919, and λ_p is the province fixed effects

[31] We extract individual profiles of male PKU graduates from several celebrity dictionaries of modern China that provide detailed information on the profiles of notable people, with Li (1988), Xiao (1988), Liao et al. (1990) and Zhu (1997) as the typical examples.

[32] This variable is constructed based on two sources. The first is individual profiles from the aforementioned celebrity dictionaries. The second is the Modern Women Journals Database and the Chinese Periodical Full-text Database (1911-1949), where we search for any relevant articles published by the students in periodicals after the coeducation reform.

controlling for provincial heterogeneity.

[Table 5 should be here]

Table 5 summarizes the results of individual-level analysis. In Panel A, we find that exposure to coeducation reform increases the probability of having more progressive norms toward girls' schooling by 10 to 20 percentage points. And the positive effect is observed across all three proxies. As the literature emphasizes the importance of direct interaction among peers in shaping individual attitudes and behaviors (Rao, 2019; Truffa and Wong, 2024), we then exploit data on students' majors from alumni records to examine the role of direct interaction with female students after the coeducation reform. Since the nine female students admitted in February 1920 all majored in humanities, we construct a dummy variable indicating whether the male student was in the same major as the first cohort of female students. The significant coefficients on the interactive term in Panel B of Table 5 suggest that the positive changes in male students' attitudes are more pronounced among those in the same majors as female students, as they were more likely to have opportunities for direct interaction. In Appendix Table A.16, we perform a robustness check by estimating equation (5) using the full sample of 903 male graduates, recoding missing proxies for gender attitudes as zero.

6.2 Elite Social Networks

How did male graduates, with more gender-equal attitudes on female education formed by the coeducation reform, change women's higher education attainment in their home counties? In this section, we discuss the role of the elite social networks in the diffusion of progressive gender norms.

During the early 20th century, most university students in China were originally from elite families (Yeh, 2000; Ren et al., 2020), and their elite social networks would facilitate the diffusion of their coeducation experience toward elite women. Literature on social networks has highlighted the facilitation of information spreading through personal connections among elites (Dippel and Heblich, 2021; Bai et al., 2023), as well as how a small group of elites is capable of shaping macro-level economic and political outcomes and changing social norms through their networks (Kim, 2007; Linton, 2015; Dippel and Heblich, 2021). Specifically, in the context of China, Bai et al. (2023) show

how elite networks of powerful individuals led to the distribution of political power at the county level in the late 19th century. Hence, we could expect that the personal connections of male PKU students with their home counties played a crucial role in spreading the experience of the coeducation reform, promoting progressive gender attitudes, and encouraging women in their networks to pursue higher education.

Although we are not able to directly measure the network between male and female students at the individual level, we exploit an aggregate-level proxy that focuses on one of the most important personal networks in historical China, clanships. Developed based on kinships, a clan is composed of individuals who trace their lineage to a common male ancestor and are typically united by a surname.[33] In pre-modern China, clanships played a pivotal role in maintaining interpersonal connections, providing public goods, and regulating social operations (Fei, 1985; Clark, 2015; Freedman, 2021), making them the most important elite networks in society (Greif and Tabellini, 2010, 2017). Following common practice in the literature on kinship, we exploit the surnames of university students in our dataset to identify whether they came from the same clan (Artiles, 2023; Ghosh et al., 2023).[34] We then construct a surname-county-year panel dataset to empirically investigate how elite social networks, formed by clanships, contribute to the positive effect of coeducation reform exposure on female higher education using the following equation:

$$\begin{aligned} Y_{sipt} = {} & \beta_1 \textit{Same Surname}_{sip} \times \textit{PKU Graduate } 1920_{ip} + \beta_2 \textit{PKU Graduate } 1920_{ip} \\ & + \beta_3 \textit{Same Surname}_{sip} + X'_{ipt}\gamma + \lambda_p \times \theta_t + \epsilon_{sipt} \end{aligned} \tag{6}$$

where Y_{sipt} is the female higher education outcomes of surname s in county i of province p in year t, and *Same Surname*$_{sip}$ is a dummy variable that equals one if the

[33] As a large-sized joint family unit, a clan typically consists of five or more generations along the paternal line of descent, ranging in size from dozens to a few hundred members (Lang, 1946; Liu, 1959; Fei and Liu, 1982). Members of the same clan generally share a common surname and reside in a single village or a cluster of neighboring villages, making the clan a territorially defined unit within a county (Fei, 1985; Clark, 2015; Freedman, 2021). They traditionally lived in close proximity, held property collectively, and worshiped their founding ancestors through shared rituals (Whyte, 1996). Loyalty to the clan involved reciprocal moral obligations and strong personal interactions, reinforcing dense social networks (Greif and Tabellini, 2017).

[34] Here we use clan, surname, and the group of people with the same surname at the county level interchangeably. Personal networks based on kinship could extend beyond surnames, as matrilineal connections were also important in Chinese society (Fei, 1985). Therefore, our measure should be interpreted as a lower bound of elite social networks based on kinship.

clan with surname s had male PKU graduates in 1919 for control counties and in 1920 for treatment counties. The rest of the variables are defined in the same way as in equation (1). We restrict our sample to counties with male PKU graduates in either 1919 or 1920, and all surnames observed in our university student database.

We present results in Table 6. Column (1) shows that, among the clans in the counties with exposure to coeducation reform through male graduates, the probability of having a female university student in a given year increased by an additional 1.68 percentage points in the clan from which the 1920 graduate originated. Given the mean of the dependent variable at 0.0004016, this effect is of great economic significance as well. Although the coefficient on *PKU Graduate* 1920_{ip} remains significant, without the personal network formed by kinships, the magnitude of coeducation reform exposure's effect on female education became negligible. In Columns (2) and (5), we control for surname-year and county-year fixed effects to capture unobserved heterogeneity at the county level or clan level that varies over time. And Columns (3) and (6) additionally account for the unobservable time-varying heterogeneity in clans with and without male PKU graduates in 1919 or 1920 by including the *Same Surname* $\times$ *Year* fixed effects. The coefficient on the interactive term remains significantly positive under these alternative specifications.

[Table 6 should be here]

Our result highlights the importance of elite social networks in amplifying the positive spillover of coeducation reform in the exposed counties. In the absence of a close connection with male students who experienced coeducation reform at PKU, people in the local area might have little access to information about the reform as well as the progressive gender norms toward female education. This finding resonates with the literature's emphasis on the role of clanships as informal institutions in shaping individual outcomes in pre-modern society (Alesina and Giuliano, 2014).

Meanwhile, the coefficient on *Same Surname* is significantly positive, suggesting that even without coeducation exposure, clans with male PKU graduates in 1919 had a higher probability of having female university students in the subsequent decade. However, the effect is much smaller than that of clans with direct exposure to the coeducation reform. The underlying explanation could be that clans with PKU graduates

maintained a stronger tradition of valuing education or possessed higher levels of human capital than other clans, benefiting the human capital accumulation of their female members after the reform.

6.3 Effects of Local Characteristics

Our analysis has thus far documented two main channels that fueled the positive spillover of coeducation reform on female education. In this section, we analyze three county-level characteristics that could affect the positive spillover: (i) proximity to educational opportunities, (ii) demand for skilled female labor, and (iii) restrictive gender norms.

6.3.1 Supply of Educational Opportunities

First, we analyze how the supply of higher educational opportunities to women affects a county's response to coeducation reform exposure. As suggested in Figure A.4, after the PKU coeducation reform, Chinese universities gradually adopted coeducation during the 1920s and early 1930s. To capture this supply-side effect, we construct a time-varying measure to account for the accessibility of any county i to universities admitting female students:

$$\textit{Univ. Access}_{ipt} = \sum_{j} \frac{\textit{FemUniv}_{jt}}{\ln \textit{Distance}_{ij}} \tag{7}$$

where $\textit{FemUniv}_{jt}$ is the number of universities admitting female students in county j in year t weighted by the size of each university,[35] normalized by the logged grand circle distance between county i and j. We estimate equation (1) by introducing the standardized index of $\textit{Univ. Access}_{ipt}$ as an interactive term with $\textit{PKU Graduate 1920}_{ip}$.

Table 7 presents the effect of access to universities admitting female students on the positive effects of coeducation reform exposure. Column (2) shows that, in the exposed counties, a one-standard-deviation increase in the access to educational opportunities increased the probability of having female students being admitted to a university by 6.74 percentage points each year. The effect remains consistent when we directly compute the index using the number of universities admitting female students in Appendix

[35] We use the average number of students between 1928 and 1934 to measure the size of a university.

Table A.17. Moreover, these results indicate that the lagged positive spillover we observe in Section 5.3 can be partially explained by the delayed supply of coeducational universities in China.

[Table 7 should be here]

6.3.2 Demand for Skilled Female Labor

We next discuss the role of labor market demand in shaping a county's response to the coeducation reform. Labor market opportunities play an important role in affecting individual schooling decisions, where the literature finds both positive and negative impacts of labor demand shocks on educational investment (Jensen, 2012; Oster and Steinberg, 2013; Atkin, 2016; Adukia et al., 2020; Bau et al., 2020).

In the lack of a detailed labor survey in the Republican period, we rely on two types of labor demand for skilled female workers. We first consider the demand from modern medical institutes, as historical anecdotes suggest that modern hospitals represented a major source of labor demand for educated women in roles as doctors (Zhang, 2007). We collected data on 945 modern medical institutes established between 1835 and 1936 from the History of Western Medicine in China (Luesink, 2016) and Chinese Medical Directory (Chinese Medical Association, 1934). Similar to equation (7), we construct a county-level time-varying measure of labor demand from health sector using county-level number of modern medical institutes weighted by the size of each institute.[36] Second, we consider the labor demand from modern firms. To capture the sectoral heterogeneity in female labor demand, we construct the following "shift-share" measure:

$$\textit{Demand-Firm}_{ipt} = \sum_{j=1}^{J} \frac{\sum_s \textit{Firm}_{jst} \times \textit{FemShare}_{s_us}}{\ln \textit{Distance}_{ij}^{\theta}} \tag{8}$$

where $\textit{Firm}_{jst}$ is the number of modern firms in county j in year t in sector s. Our firm data is compiled from Du (1991, 2019), covering over 6,500 modern firms established in China between 1840 and 1936. As there is no systematic information on the share of female workers at either the firm level or sector level in the Republican period, we rely on the average female share in each sector from the 1920 U.S. Census (U.S. Census

[36] We use the total number of doctors and nurses in a medical institute to measure its size.

Bureau, 1922) and match the sector between the U.S. Census and our firm data.[37]

As shown in Table 8, labor demand for skilled female workers increased the positive spillover on female education brought by the coeducation reform. Column (2) of Panel A suggests a one-standard-deviation increase in the demand from medical institutes increased the positive effect by 7.72 percentage points, and Column (2) of Panel B suggests a one-standard-deviation increase in the demand from modern firms increased the positive effect by 4.71 percentage points. The results remain robust when we compute the demand index using equation (7) directly incorporating the unweighted number of medical institutes or modern firms, as reported in Appendix Table A.18. These results reveal that a larger demand for female workers would increase people's perceived return to educational investment (Jensen, 2012) and thus amplify the positive effect on female education in the exposed counties. Meanwhile, the significant coefficient on the *PKU Graduate 1920* and the insignificant coefficients on the labor demand indexes suggest that the positive spillover in the exposed counties cannot be fully explained by labor market demand, highlighting the importance of experiencing coeducation reform exposure.

[Table 8 should be here]

6.3.3 Restrictive Gender Norms

Last, we examine how the positive effect brought by the exposure to coeducation reform was affected by traditional gender norms in the local area. These norms, rooted in Confucianism, regulated the division of gender roles under a patriarchal family structure in for more than 1800 years (Slote and De Vos, 1998; Peterson, 2016), constrained women's participation in non-domestic activities, and suppressed their intellectual talent (Whyte, 1996; Ebrey, 2003).

However, the effect of restrictive gender norms in the exposed counties remains unclear. On the one hand, it may attenuate the positive effect if people perceive the coeducation reform as incompatible with their priors or interests (Ditto and Lopez,

[37]The underlying assumption is that the distribution of female representation across industries is similar in the U.S. and China. This assumption is plausible given that China's modern industries initially emerged from foreign investment and closely mirrored patterns in the Western world. Furthermore, using U.S. sector-level female representation to construct the index enhances its exogeneity to the treatments occurring in China, making it more suitable for our empirical setup.

1992; Dewatripont and Tirole, 2005; Gentzkow and Shapiro, 2006).[38] On the other hand, the positive effect brought by social networks may be more pronounced in counties with stronger traditional norms. Personal experience enhances the credibility of new ideas, making people more likely to accept them (Benabou and Tirole, 2011), and this effect may be stronger in conservative regions, where traditional social norms are more resistant to change.

To examine which hypothesis holds, we follow Kung and Ma (2014) and use the number of *Zhenjie Paifang* (*Paifang*) as a measure of traditional gender norms. *Paifang* is a form of arch built to honor women for their chastity as wives or filial piety as daughters, whose existence reflects the emphasis on women's subordination and loyalty in Confucian ethics. We collect information on over 800 *Paifang* officially established in the Ming and Qing dynasties (1368-1912). We compute the density of *Paifang* at the county level by normalizing the total number of *Paifang* by county area, and construct a dummy variable for the intensity of traditional gender norms, in which a county is defined as having a high *Paifang* density if its *Paifang* density is above the sample mean.

Table 9 presents the results estimated by including the *Paifang* density dummy as an interactive term with *PKU Graduate 1920*$_{ip}$ in equation (1). Column (2) shows that in counties with higher *Paifang* density, the positive effects of coeducation reform exposure on a county's probability of having female university students increased by an additional 15.92 percentage points. The negative coefficient on the *Paifang* density dummy reflects that restrictive gender norms alone hindered women's human capital accumulation. However, the positive interactive term indicates that within counties exposed to coeducation reform through male PKU graduates, the positive spillover on female education was larger in counties more deeply entrenched in traditional gender norms. Combining with the findings in Section 6.2, this finding suggests that male students' personal networks enhance the credibility of new ideas (Benabou and Tirole, 2011), making their positive effects more pronounced in counties with stronger traditional gender norms, where personal experience plays a critical role in overcoming cultural barriers against women's education.

[Table 9 should be here]

[38] Some historians have documented that the coeducation reform received criticism in the conservative regions, as people regard the break of gender segregation in universities as a "moral bankruptcy" (Lei et al., 1993; Xiong, 1995).

7 Effects on the Mass Education of Girls

In this section, we extend our discussion to the effect on the mass education of girls to study whether the spillover reached the general public outside the elite social networks and changed their willingness to send their daughters to school.

7.1 Effects on Female Primary Education

We use female enrollment in primary schools to measure the effect on the mass education of girls. While higher education was primarily an elite privilege in early 20th-century China (Curran, 1986; Yeh, 2000; Chen, 2007), women's entrance into primary education reflected the opinions on female schooling held by the general public (Bailey, 2007). We digitize provincial primary education statistics from historical archives and construct a novel county-level cross-sectional dataset on female primary school enrollment in the early 1930s,[39] covering 1,365 counties in 16 provinces.[40]

Estimating under the same quasi-experimental framework, Table 10 shows no significant effect on female enrollment in primary schools in the home counties of exposed male graduates. The result remains consistent when using the alternative measure of female enrollment per capita. Contrary to the positive spillover on female higher education, this finding indicates a limited spillover of coeducation reform exposure on female primary education.

[Table 10 should be here]

7.2 Understanding the Limited Spillover

We consider three possible explanations of the null effect on female primary education: (i) household financial constraints, (ii) crowding out of female teachers, and (iii) stagnation of gender norms held by the general public.

[39] The cross-sectional nature of the dataset is restricted by the limited quality of education statistics in the 1920s and 1930s. It was not until the military victories of the *Kuomintang* in 1926-1928 that China was officially reunified for the first time after the 1911 Revolution. Only then were local governments able to conduct thorough surveys at the county level, although their surveys were still often interrupted by warlord conflicts or Communist uprisings. Moreover, most education statistics in this period were lost during the Second Sino-Japanese War (1937-1945) and the Second Chinese Civil War (1945-1949).

[40] Counties under Communist control are not included, as the data in these counties was not available.

7.2.1 Household Financial Constraints

Non-elite families may have been financially constrained in investing in daughters' education, even if their attitudes toward girls' schooling had changed. We rule out this explanation by estimating female enrollment in tuition-free junior primary schools, which alleviated the educational cost for poor families (Xiong, 2006).[41] However, Appendix Table A.19 shows no significant effect on female enrollment in junior primary schools, suggesting that coeducation reform exposure did not improve female primary education, even without financial barriers.

7.2.2 Crowding out of Female Teachers

If more female secondary school graduates pursued university in the exposed counties, it might reduce the supply of female primary school teachers,[42] deterring parents from sending daughters to school due to norms favoring gender segregation (Pang-White, 2022). However, Appendix Table A.20 shows no significant decrease (nor increase) in female primary school teachers in exposed counties relative to control counties, indicating that the increased human capital accumulation of elite women did not affect the size of female teachers in primary education.

7.2.3 Stagnant Gender Norms

After ruling out two possible explanations, the null effect on primary education most likely reflects stagnant gender norms on female education among the general public, rather than the increased willingness to educate girls being offset by other constraints. We argue that, although progressive norms spread among elite social networks, male PKU graduates did not foster widespread discourse on female education and women's empowerment, limiting the coeducation reform's benefit on the mass schooling of girls in the exposed counties.

We leverage women's periodicals to measure gender-related popular discourse at the county level. In the 1920s and 1930s, periodicals were key mediums for Chinese

[41] Primary education in the Republican period was divided into a four-year junior education and a two to three years senior education.

[42] Teacher was a popular career choice for female graduates from secondary schools and vocational teacher-training schools in early 20th-century China (Lei et al., 1993; Bailey, 2007).

intellectuals and activists to disseminate their ideas to larger audiences (MacKinnon, 1997; Mittler, 2004; Bai et al., 2024) and women's periodicals increasingly reflected fundamental changes in gender norms (Mann, 2011; Hockx et al., 2018). Our data, collected from the Modern Women Journals Database and the Chinese Periodical Full-text Database of the Republican Period (1911-1949) using a machine learning algorithm, includes 104,241 articles from 321 women's periodicals published between 1898 and 1936.[43] We measure county-level gender-focused popular discourse using this novel data and examine whether exposure to coeducation reform increased public discussions on gender topics under a standard difference-in-differences framework.[44]

Table 11 shows that exposure to the coeducation reform failed to generate gender-focused popular discourse, either measured by the establishment of new women's periodicals or the writings of articles on existing ones. The null effect remains when we focus on articles related to female education in Columns (5) and (6), or when we restrict the sample to progressive women's periodicals in Appendix Table A.21.[45]

[Table 11 should be here]

Together, our results suggest that the null effect of coeducation reform exposure on the mass schooling of girls stemmed from the limited impact of male graduates on changing the gender attitudes held by the general public. Without sufficient local discussions on female education, elite students' coeducation experiences could hardly raise public awareness of the importance of educating women. This finding further helps to explain the stagnation of female human capital accumulation and the considerable female illiteracy in China until the 1950s (Luo, 1994).

[43] For the second data source, we use a machine learning algorithm to analyze the description of each periodical and identify periodicals with a focus on gendered topics as women's periodicals.

[44] We construct two relevant variables. First, based on publisher information, we create a dummy for whether a new women's periodical was established in a county in a given year. Second, using authors' biographies, we calculate the number of articles in women's periodicals published by authors from a certain county.

[45] Based on their descriptions, within the 321 periodicals in our sample, 166 of them are progressive periodicals, 143 of them are commercial periodicals or center in the political spectrum, and the rest 12 periodicals are conservative periodicals advocating traditional gender norms.

8 Conclusion

Exposure to social diversity can change individual attitudes and reduce stereotypes and prejudice. In this paper, we show that the exposure to diversity can further improve real economic outcomes when the exposed individuals spread the more egalitarian attitudes through their social networks. In particular, we examine the spillover effect of the first coeducation reform in China's higher education: the admission of female students into Peking University in 1920. We focus on how exposure to gender diversity affected male students' attitudes toward female education and subsequently led to spillovers in their home counties. We utilize the unexpected timing of the reform to compare female higher education outcomes in counties with and without exposure.

Our quasi-experimental approach confirms a significantly positive impact of coeducation exposure on female university enrollment. A back-of-the-envelope calculation suggests that 39% of the increase in a county's probability of having female students admitted to university between 1920 and 1936 can be attributed to the positive spillover of coeducation reform.

Two mechanisms mainly explain the positive spillover of the coeducation reform in the exposed male students' home counties. The coeducation reform first changed the exposed male cohort's attitudes on female education toward a more progressive direction, reflected by their documented advocacy for female education, marriage outcomes, and career choices. When these male students brought more progressive attitudes on girls schooling back to their home counties, their elite social networks, which we measure by clanships using surname information of university students, played a crucial role in spreading the norms and motivating female students in the same clan to pursue higher education.

Our findings suggest a novel perspective on how exposure to gender diversity shapes the formation of more egalitarian gender attitudes: progressive attitudes, carried by men, spread through elite networks across regions and positively affect individual preferences and decisions among a broader population of elites. We thus highlight the role of personal networks as informal institutions in affecting individual behaviors and fueling social changes, which remains important today in developing countries as complements to formal institutions (Kinnan and Townsend, 2012; Breza, 2016; Munshi

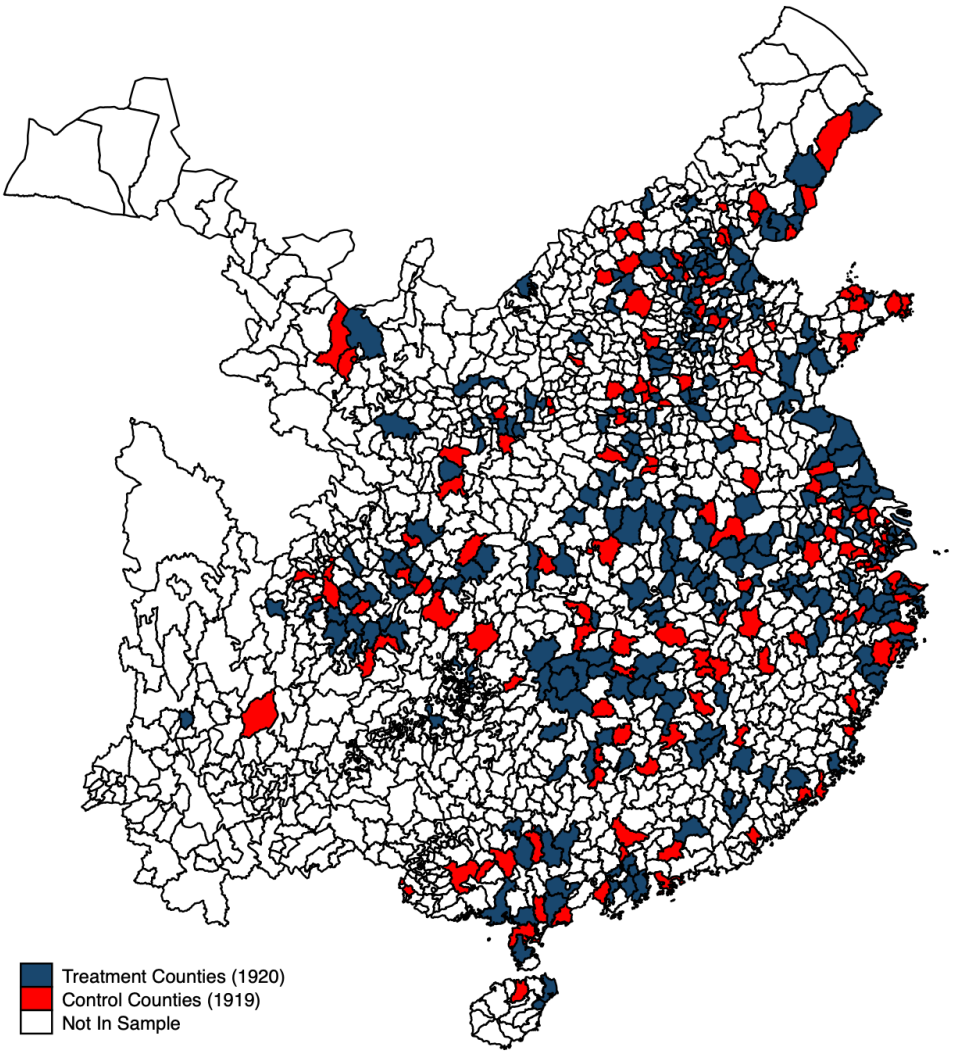
and Rosenzweig, 2016; Heß et al., 2021; Banerjee et al., 2024).

Meanwhile, we illustrate the limitations of elites in promoting social change. We observe a null effect on the mass education of girls, measured by female enrollment in primary schools in the 1930s. Based on a textual analysis on women's periodicals, we show that the null effect reflects the stagnation in the gender norms held by the general public. With the lack of connections outside the elite social networks, elites may not be able to effectively spread the progressive norms to a broader population. Consequently, despite the increased human capital accumulation of elites, we might observe an increasing disparity in the well-being between the elites and non-elites.

Today, male-biased gender norms still hinder gender equality in the labor market, educational attainment, and personal well-being (Jayachandran, 2015, 2021). While this study focuses on the norms of female schooling in early 20th-century China, the findings are relevant for understanding the change in gender norms concerning other dimensions in many developing countries with conservative gender norms today. When initiating women empowerment programs, social networks of the affected group have the potential to spread progressive norms that bring positive spillovers to more people. However, the spillover through social networks might not benefit the broader population outside the networks, which in turn expand the disparity among different groups of women.

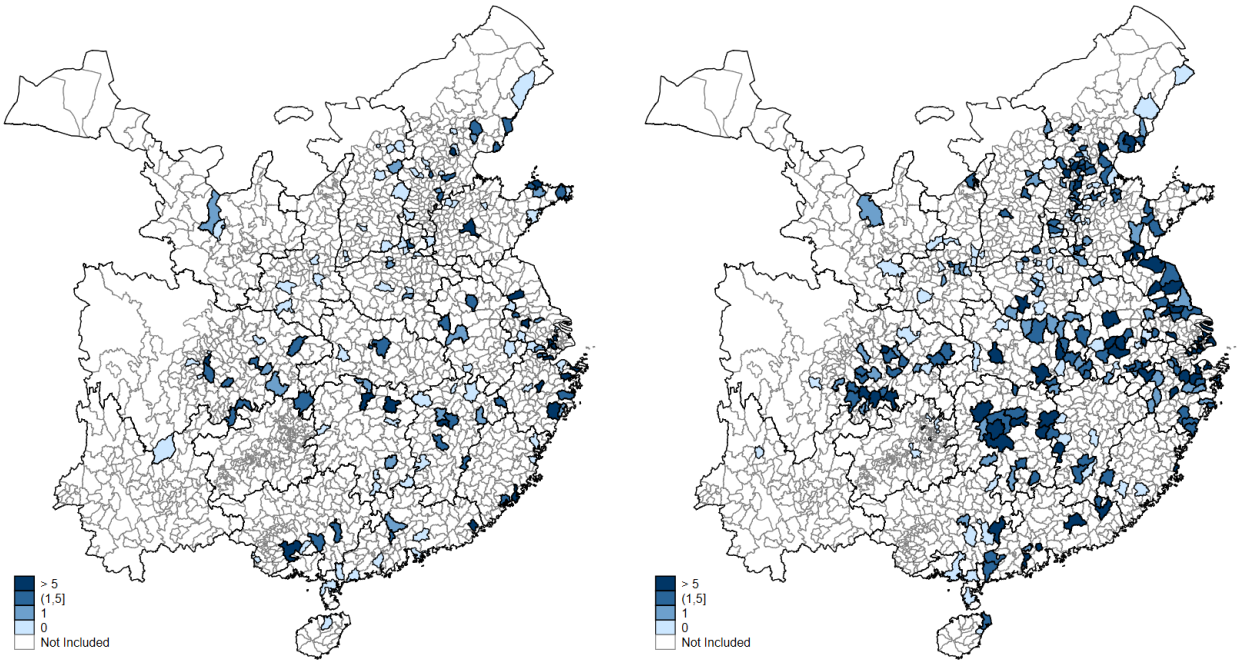
Figures and Tables

Figure 1: Geographic Distribution of Coeducation Reform Exposure



Notes: Figure 1 depicts the geographic distribution of the home counties of male PKU students who graduated in 1919 and 1920 by their year of graduation. Blue denotes home counties of the 1920 cohort. Red denotes home counties of the 1919 cohort. White denotes the counties included in our dataset but not included in the baseline sample, as they do not have male PKU students graduated in either 1919 or 1920. Frontier provinces and areas occupied by foreign powers are excluded from this map. Data on the home counties of PKU graduates come from the alumni records of Peking University.

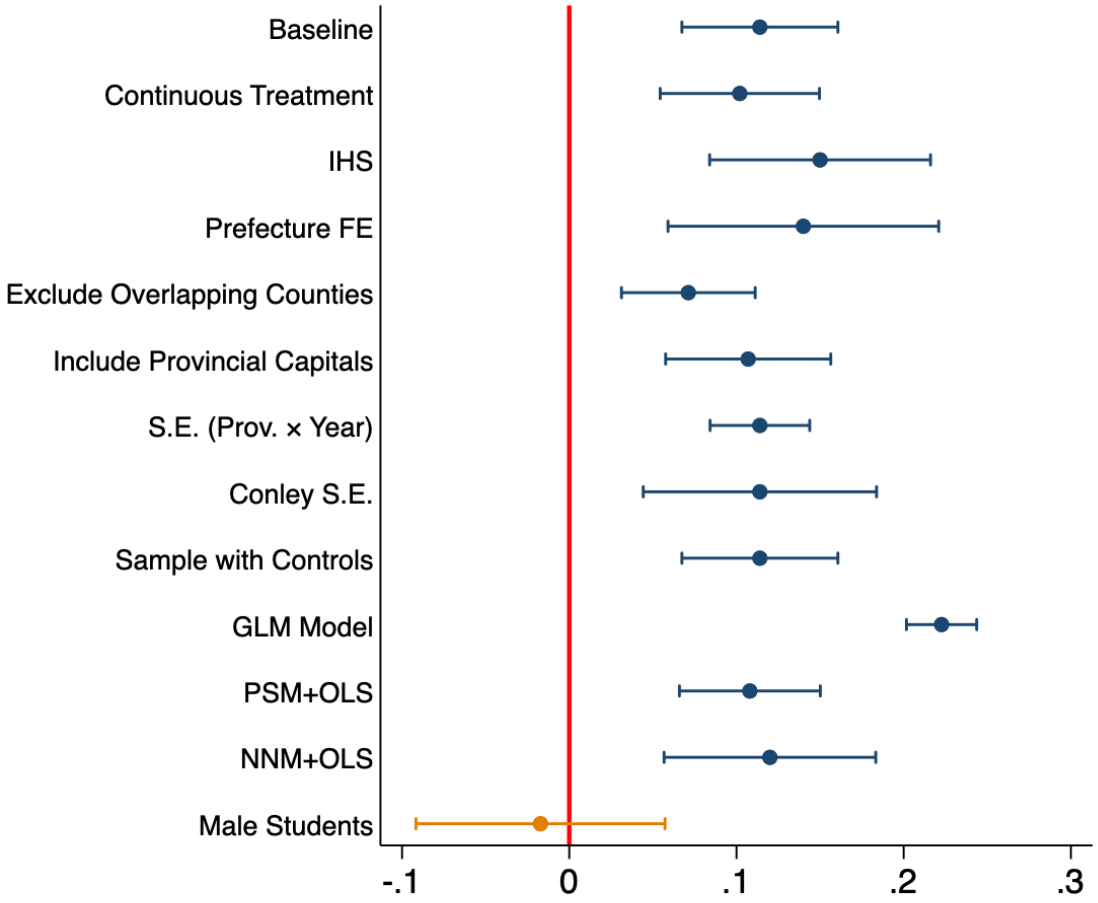
Figure 2: Geographic Distribution of Female University Students



(a) Control (1919) Counties (b) Treatment (1920) Counties

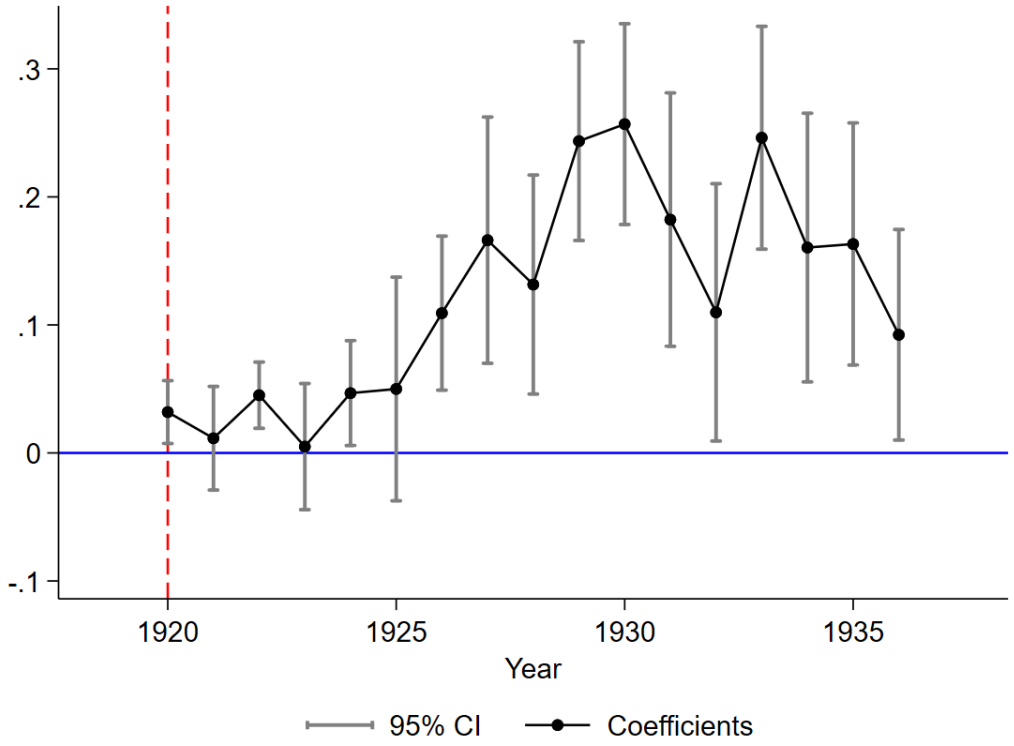
Notes: Figure 2 depicts the geographic distribution of female university students between 1920 and 1936 from the home counties of male PKU students who graduated in 1919 and 1920, respectively. The darkness of blue denotes the number of female university students. White denotes the counties included in our dataset but not included in the baseline sample. Frontier provinces and areas occupied by foreign powers are excluded from this map. Data on female university students come from our university student database, as described in Section 3.1.

Figure 3: Summary of Robustness Checks on Female Higher Education



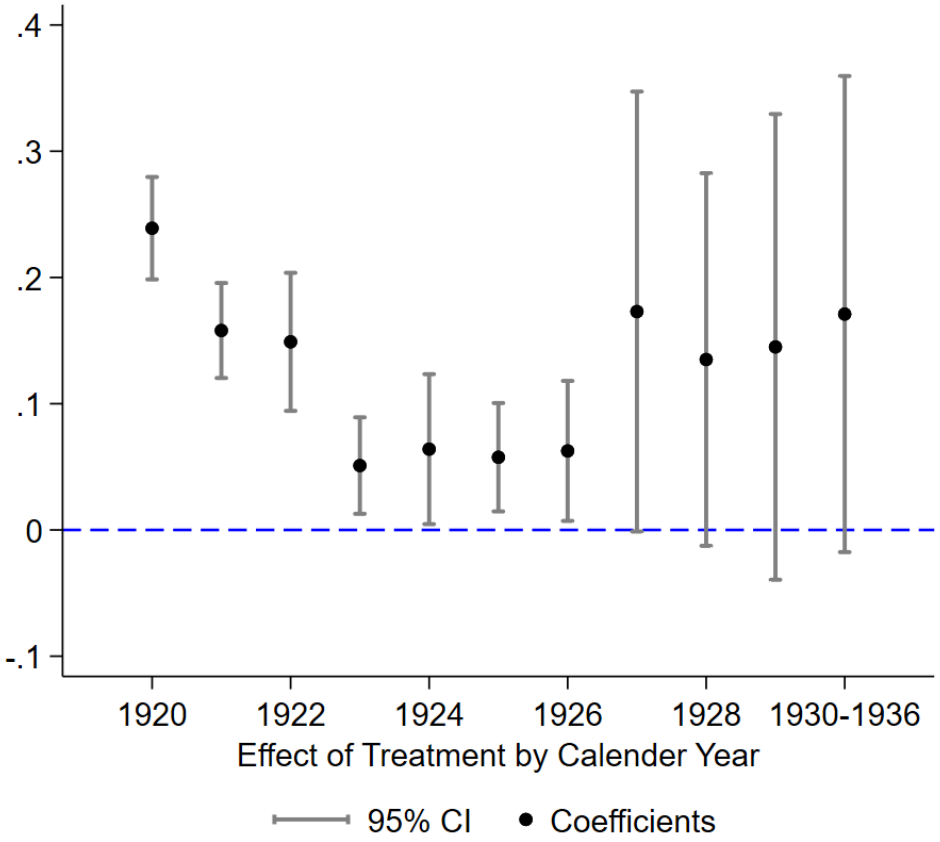
Notes: Figure 3 summarizes the coefficients on *PKU Graduate* 1920_{ip} and their 95% confidence intervals of the baseline estimation in Section 5.1 and robustness checks in Section 5.6. The dependent variable is the dummy indicating the existence of female students admitted to universities.

Figure 4: Dynamic Effects on Female Higher Education Outcomes



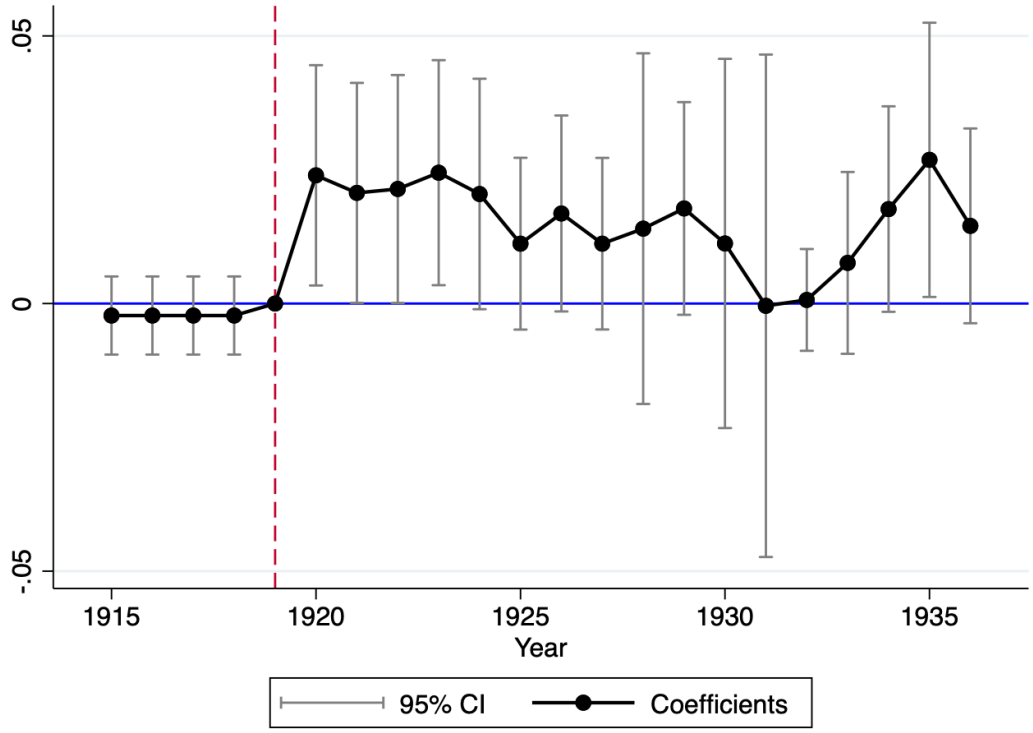
Notes: Figure 4 estimates equation (1) by each year between 1920 and 1936 separately, and reports the coefficients and 95% confidence intervals of *PKU Graduate* 1920_{ip}. The dependent variable is the dummy indicating the existence of female students admitted to universities.

Figure 5: Effects on Female Higher Education Outcomes by Cohorts



Notes: Figure 5 shows the average treatment effect of each PKU cohort after the coeducation reform under a staggered DID estimation. As the size of counties first being treated in the 1930s is relatively small, we combine counties that were treated between 1930 and 1936 into one group. The control group is counties that were not yet treated at each year. The dependent variable is the dummy indicating the existence of female students admitted to universities.

Figure 6: Effects on Female Students in Japanese Universities, Event Study



Notes: Figure 6 estimates equation (4) using county-year panel data on female Chinese students in Japanese universities between 1915 and 1936, and reports the coefficients and 95% confidence intervals of *PKU Graduate* $1920_{ip} \times Year_t$. The dependent variable is the dummy indicating the existence of female students admitted to universities.

Table 1: Summary Statistics

	Variable	Obs	Mean	Std. dev.	Min	Max	Source
Dependent variables	Female University Students Dummy	28118	0.067	0.250	0	1	A
	ln Female University Students	28118	0.058	0.232	0	2.773	A
	ln Female University Students per 1 Million Women	12529	0.214	0.702	0	6.254	A, B
Independent variables	PKU Graduate 1920	323	0.789	0.408	0	1	A
Control variables	ln County Area (10 thousand km^2)	1653	0.188	0.168	0.001	2.283	C
	ln Distance to Major River (km)	1654	3.982	1.872	0	6.337	C
	ln Distance to Coast (km)	1654	5.320	1.814	0	7.509	C
	ln Distance to Treaty Port (km)	1654	4.865	1.172	0	6.465	D
	ln Distance to Provincial Capital (km)	1654	4.815	0.912	0	7.055	C
	ln Slope	1653	1.169	0.712	0.015	2.944	C
	ln Ruggedness	1653	4.472	1.572	0.471	7.076	C
	ln Rainfall (mm)	1653	6.909	0.537	4.528	7.706	C
	ln Temperature ($^\circ C$)	1652	2.710	0.323	0.588	3.263	C
	ln Land Quality for Agriculture	1654	0.509	0.140	0.000	0.693	E
	ln Population Density (per km^2)	978	4.903	0.890	0.141	8.116	D, F
	ln Num. of Modern Firms per capita	963	0.083	0.238	0.000	3.976	G
	ln Num. of Modern Banks per capita	963	0.024	0.118	0.000	3.301	G
	ln Num. of *Jinshi* per capita	954	0.529	0.563	0.003	7.176	H
	ln Num. of *Shengyuan* Quota per capita	946	0.514	0.451	0.027	7.199	I
	ln Num. of Christians per capita	823	0.691	0.603	0.001	5.519	F

Notes: A: university student database described in Section 3.1; B: Ministry of Interior (1931); C: Harvard Yenching Institute (2007); D: Zhang (1993); E: Food and Agriculture Organization (2012); F: Stauffer (1922); G: Du (1991); H: Zhu and Xie (1980); I: Bai and Jia (2016). When the variable takes "ln", it indicates the natural logarithmic form (plus one). Numbers of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians are normalized by population before logarithmic transformation.

Table 2: Balance Checks

Panel A. Geographic Characteristics

	(1) County Area	(2) Dist. to Major River	(3) Dist. to Coast	(4) Dist. to Treaty Port	(5) Dist. to Provincial Capital	(6) Slope	(7) Ruggedness	(8) Rainfall	(9) Temperature	(10) Land Quality
PKU Graduate 1920	0.0193	-4.577	-4.145	-10.05	-14.45	-0.298	-15.85	-10.61	0.233	0.00588
	(0.0228)	(11.96)	(15.05)	(12.19)	(13.03)	(0.287)	(14.87)	(20.10)	(0.213)	(0.0208)
Observations	323	323	323	323	323	323	323	323	323	323
Mean of Dep. Variable	0.199	129.3	337.6	157.7	140	2.069	127.4	1128	15.02	0.752
S.D. of Dep. Variable	0.149	112.8	318.3	137.7	87.06	2.132	123.4	495.2	3.503	0.198

Panel B. Social Characteristics

	(11) Population Density	(12) Male Population Density	(13) Female Population Density	(14) Num. of Chinese Firms	(15) Num. of Chinese Banks	(16) Num. of *Jinshi*	(17) Num. of *Shengyuan* Quota	(18) Num. of Christians	(19) Num. of Telegraph Stations	(20) Dist. to Railway
PKU Graduate 1920	31.96	8.024	4.702	1.338	-0.366	-11.86	2.266	-10	0.0692	-10.41
	(25.93)	(15.97)	(14.61)	(10.57)	(1.071)	(26.99)	(7.737)	(112.5)	(0.0911)	(11.23)
Observations	242	169	169	320	320	314	312	224	323	323
Mean of Dep. Variable	253	136.7	112.7	34.01	4.547	189.4	122.4	502.9	0.272	158.7
S.D. of Dep. Variable	242.2	108.7	95.35	102.8	7.835	200.2	65.84	966.5	0.673	173.4

Notes: Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. All regressions control for provincial fixed effects. PKU Graduate 1920 is a dummy variable that equals one when a county had at least one PKU male student graduated in 1920; otherwise, it indicates the county had no PKU male student graduated in 1920 but had at least one PKU male student graduated in 1919.

Table 3: Effects on Female Higher Education, Baseline Results

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920	0.1207***	0.1140***	0.1207***	0.1164***	0.2951***	0.3504***
	(0.0192)	(0.0238)	(0.0206)	(0.0261)	(0.0705)	(0.0879)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	5491	3723	5491	3723	2873	2414
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table 4: Effects on Female Higher Education, Staggered DID, Not-yet-treated

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate	0.1557***	0.1832***	0.1412***	0.1738***	0.3913***	0.7242
	(0.0124)	(0.0571)	(0.0119)	(0.0513)	(0.0530)	(0.4477)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	14340	8172	14340	8172	7404	5604
County FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. The sample used in this analysis contains all counties that had at least one PKU graduate during 1898-1948, and the estimation uses not-yet-treated counties as control group. *PKU Graduate* is a dummy variable that equals 1 once a county had at least one male PKU graduate with coeducation experience (graduated between 1920 and 1936) in any given year, and 0 otherwise. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table 5: Effects on Male Students' Gender Attitudes

	Support Female Education	Marry Woman with College Education	Teach in Girls' Schools
	(1)	(2)	(3)
Panel A. Baseline			
Graduate 1920	0.182***	0.0944***	0.126***
	(0.0445)	(0.0344)	(0.0425)
Panel B. Heterogeneity of Majors			
Graduate 1920 × Same Major	0.238***	0.124	0.277***
	(0.0876)	(0.0830)	(0.0934)
Graduate 1920	0.0665	0.0306	-0.0102
	(0.0481)	(0.0336)	(0.0378)
Same Major	0.0432	0.0453	0.0612
	(0.0430)	(0.0479)	(0.0563)
Mean of Dep. Variable	0.1518	0.0804	0.1161
Observations	224	224	224
Province FE	YES	YES	YES

Notes: Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. *Graduate 1920* is a dummy variable that equals 1 when a male PKU student was graduated in 1920, and 0 when the student was graduated in 1919. *Same Major* is a dummy variable that equals one if the student was in the same major as the first cohort of female students.

Table 6: Effects of Elites' Social Networks on Female Higher Education

	Dummy - Having Female University Students			ln (1+Number of Female) University Students)		
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920 × Same Surname	0.0168***	0.0147***	0.0152***	0.0123***	0.0107***	0.0111***
	(0.00446)	(0.00343)	(0.00348)	(0.00335)	(0.00257)	(0.00261)
PKU Graduate 1920	0.000196***			0.000137***		
	(0.0000673)			(0.0000495)		
Same Surname	0.00688**			0.00498**		
	(0.00337)			(0.00252)		
Mean of Dep. Var.	0.0004016	0.0004016	0.0004016	0.0002887	0.0002887	0.0002887
Observations	2431136	3590944	3590944	2431136	3590944	3590944
Province × Year FE	YES	(YES)	(YES)	YES	(YES)	(YES)
Geo. Controls × Time Trend	YES	(YES)	(YES)	YES	(YES)	(YES)
Social Controls × Time Trend	YES	(YES)	(YES)	YES	(YES)	(YES)
County × Year FE		YES	YES		YES	YES
Surname × Year FE		YES	YES		YES	YES
Same Surname × Year FE			YES			YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. Regressions are at surname-county level. *Same Surname* is a dummy variable that equals 1 if the clan with certain surname had at least one male PKU graduate in 1919 for control counties and in 1920 for treatment counties, and 0 otherwise. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table 7: Heterogeneous Effects of Supply of Female Educational Opportunities

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920 × Univ. Access	0.0634***	0.0674***	0.0669***	0.0735***	0.169***	0.226***
	(0.0113)	(0.0152)	(0.0131)	(0.0179)	(0.0439)	(0.0591)
PKU Graduate 1920	0.118***	0.108***	0.118***	0.110***	0.278***	0.320***
	(0.0188)	(0.0220)	(0.0201)	(0.0236)	(0.0658)	(0.0766)
Univ. Access	0.111	-0.251	0.0686	-0.381	0.000557	-1.114
	(0.309)	(0.231)	(0.384)	(0.277)	(1.116)	(0.817)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	5474	3723	5474	3723	2856	2397
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Univ. Access* is the sum of the total number of students (average 1928-1934) in the universities admitting female students in all counties normalized by the great-circle distance. *Univ. Access* is normalized by the sample mean.*Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table 8: Heterogeneous Effects of Labor Demand for Female Workers

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Modern Medical Institutes						
PKU Graduate 1920 × Demand-Med	0.0689***	0.0772***	0.0732***	0.0857***	0.191***	0.250***
	(0.0135)	(0.0178)	(0.0161)	(0.0214)	(0.0551)	(0.0666)
PKU Graduate 1920	0.114***	0.0986***	0.113***	0.0983***	0.249***	0.286***
	(0.0178)	(0.0200)	(0.0189)	(0.0211)	(0.0585)	(0.0702)
Demand-Med	0.107	-0.110	0.0759	-0.206	0.175	-0.365
	(0.136)	(0.157)	(0.165)	(0.187)	(0.571)	(0.571)
Panel B. Modern Firms						
PKU Graduate 1920 × Demand-Firm	0.0469***	0.0471***	0.0482***	0.0495***	0.127***	0.174***
	(0.00945)	(0.0125)	(0.0102)	(0.0136)	(0.0360)	(0.0505)
PKU Graduate 1920	0.120***	0.114***	0.120***	0.117***	0.286***	0.345***
	(0.0191)	(0.0238)	(0.0205)	(0.0264)	(0.0703)	(0.0838)
Demand-Firm	19.70***	9.030	23.58**	13.09	47.30*	32.98
	(7.195)	(6.413)	(9.862)	(8.443)	(24.33)	(27.67)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	5474	3723	5474	3723	2856	2397
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Demand-Med* is the sum of the number of doctors and nurses in medical institutes in all counties normalized by the great-circle distance from these medical institutes to the county. *Demand-Firm* is an index that captures the potential demand of female workers by the modern firms in all counties normalized by the great-circle distance from these firms to the county. Both *Demand-Med* and *Demand-Firm* are normalized by the sample mean. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table 9: Heterogeneous Effects of Traditional Gender Norms

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920 × High *Paifang* Density	0.1768***	0.1592**	0.2198***	0.1986***	0.4357**	0.3329
	(0.054)	(0.062)	(0.067)	(0.069)	(0.191)	(0.212)
PKU Graduate 1920	0.0836***	0.0740***	0.0741***	0.0665**	0.1799**	0.2552**
	(0.020)	(0.025)	(0.020)	(0.027)	(0.072)	(0.099)
High *Paifang* Density	-0.0813*	-0.1063*	-0.0849	-0.1301**	-0.1573	-0.1264
	(0.047)	(0.056)	(0.052)	(0.061)	(0.172)	(0.184)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	5491	3723	5491	3723	2873	2414
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *High Paifang Density* is a dummy that equals one if the normalized number of *Paifang* of a county is higher than the sample mean. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table 10: Effects on Female Primary Education

	ln (1+Number of Female Students in Primary Schools)		ln (1+Number of Female Students in Primary Schools per 1 Million Women)	
	(1)	(2)	(3)	(4)
PKU Graduate 1920	0.2262	-0.1513	-0.2073	-0.2775
	(0.1583)	(0.1854)	(0.2081)	(0.3444)
Mean of Dep. Var.	5.938	5.938	8.3051	8.3051
Observations	300	210	161	135
Province FE	YES	YES	YES	YES
Geo. Controls		YES		YES
Social Controls		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table 11: Effects on Gender-Related Popular Discourse

	Dummy - Establishment of Women's Periodicals		ln (1+Number of Articles on Women's Periodicals)	
	(1)	(2)	(3)	(4)
PKU Graduate 1920 × Post	0.00305*	0.00470	0.0205	0.0111
	(0.00171)	(0.00368)	(0.0282)	(0.0394)
Mean of Dep. Var.	0.0018	0.0018	0.066	0.066
Observations	11914	8066	11914	8066
County FE	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES
Social Controls × Time Trend		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Post* is a dummy variable indicates the post-reform period. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

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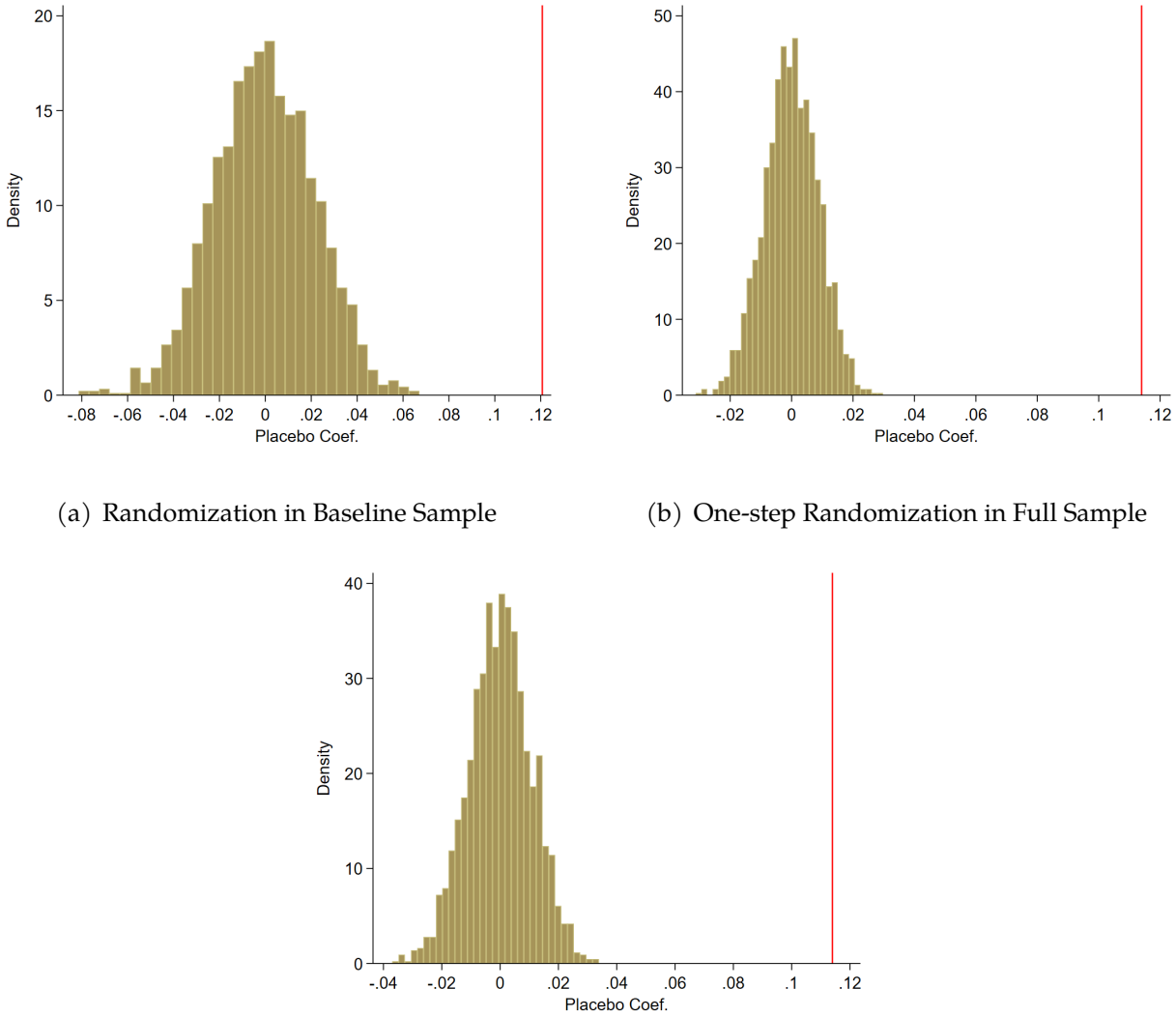
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Appendices

A Appendix Figures and Tables

Figure A.1: Randomization Inference



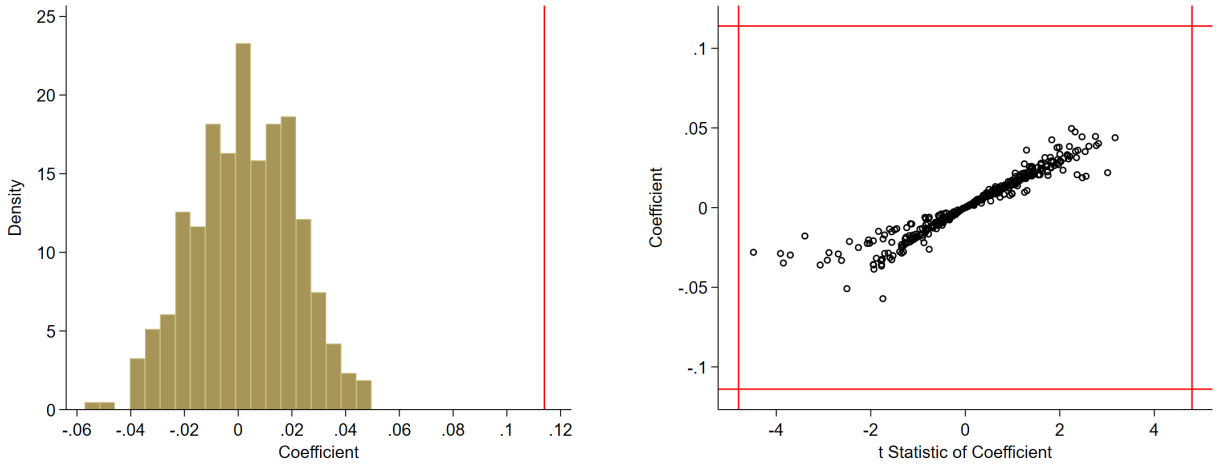
(a) Randomization in Baseline Sample

(b) One-step Randomization in Full Sample

(c) Two-step Randomization in Full Sample

Notes: Figure A.1 shows the distribution of coefficients on *PKU Graduate* 1920_{ip} in the randomization inference, as described in Section 5.6.3. For each randomization method, we repeat the randomization 1,000 times and estimate equation (1) for the main outcome variable, a dummy variable indicating the existence of female university students per year, in each iteration. Subfigure (a) conducts the randomization in the baseline sample of 1919 and 1920 cohorts, Subfigure (b) conducts a one-step randomization in the full sample, and Subfigure (c) conducts a two-step randomization in the full sample. Red vertical line shows the true effect in Column (2) of Table 3.

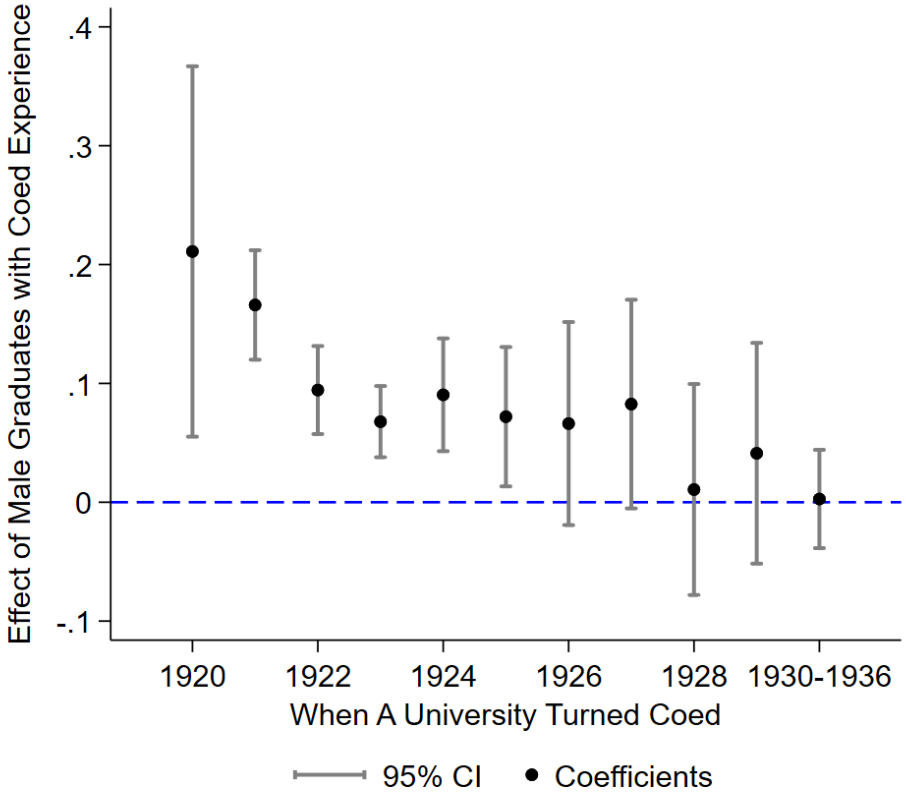
Figure A.2: Placebo Test within Treatment and Control Group



(a) Distribution of Coefficients (b) Scatter Plot of Coefficients and t-Statistics

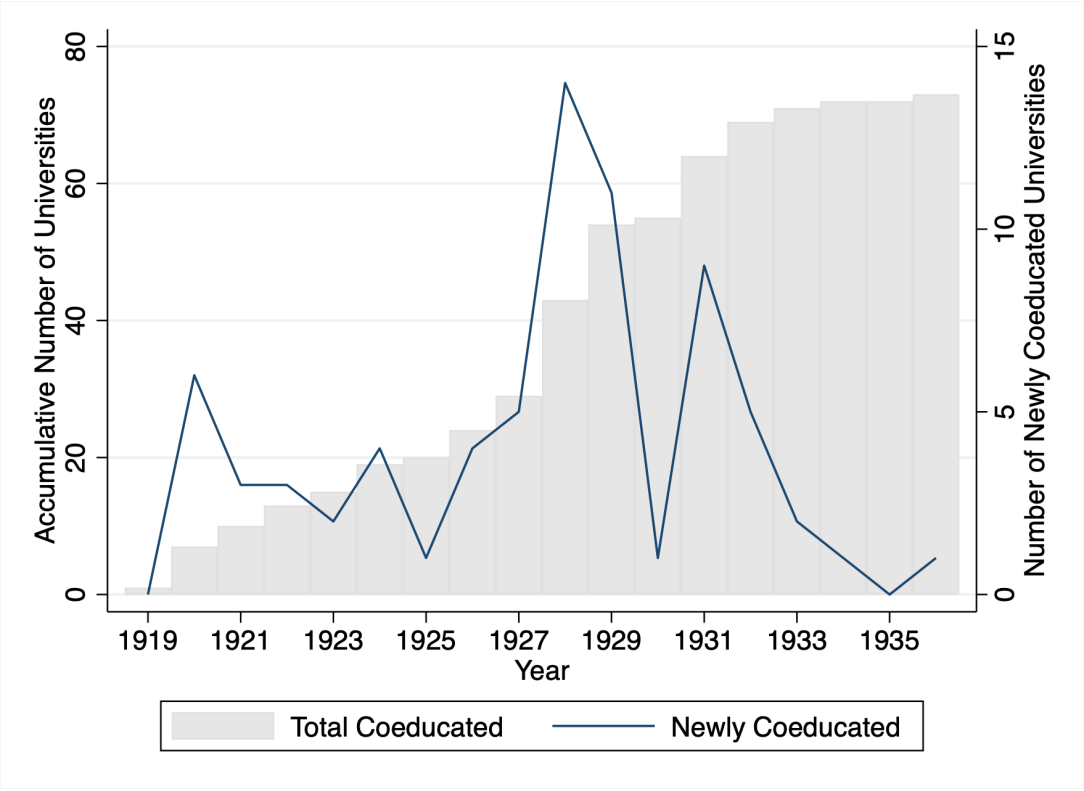
Notes: Figure A.2 shows the distribution of coefficients and t-statistics of *PKU Graduate* 1920_{ip} in our second placebo test, as described in Section 5.6.3. Subfigure (a) shows the distribution of coefficients, and the red vertical line shows the true coefficient in Column (2) of Table 3. Subfigure (b) shows the scatter plot of each coefficient and t-statistic combination, and the red vertical and horizontal lines show the true coefficient and t-statistic in Column (2) of Table 3 as well as their opposite numbers. All regressions in this placebo test estimate equation (1) with the dummy indicating the existence of female university students as dependent variable.

Figure A.3: Effects of Follow-up Universities by Years of Turning Coed



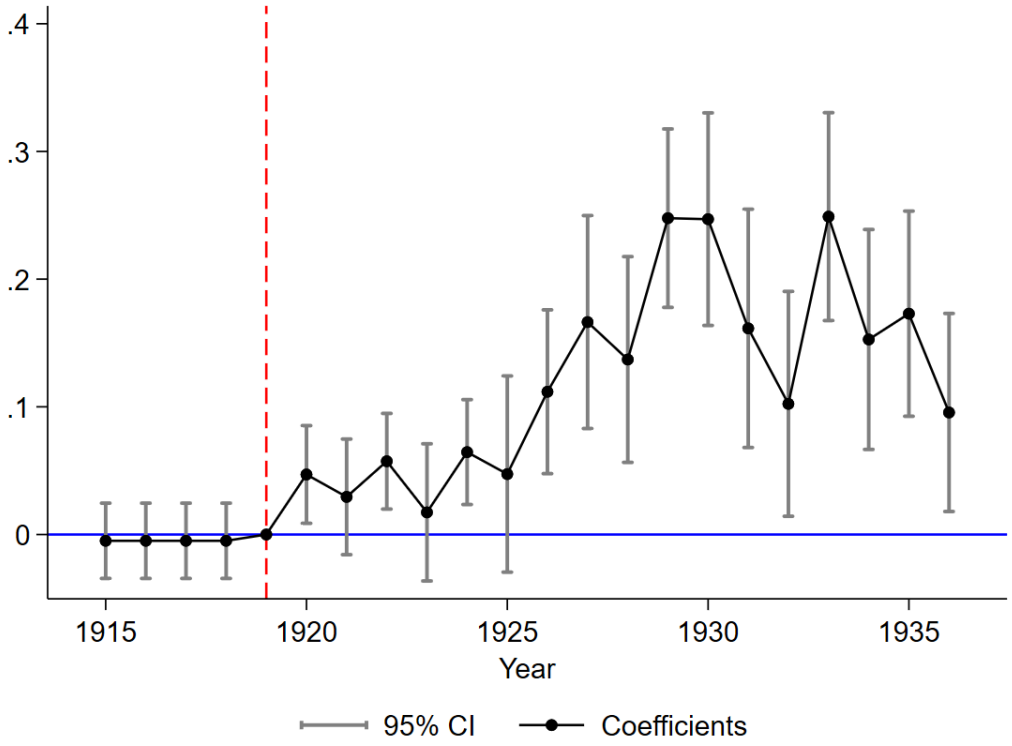
Notes: Figure A.3 estimates equation (2) by periods of follow-up universities turning coeducation, and reports the coefficients and 95% confidence intervals of $Coed\ Graduate_{ipt}$ for each reform period.

Figure A.4: Number of Universities Transitioned to Coeducation by Year



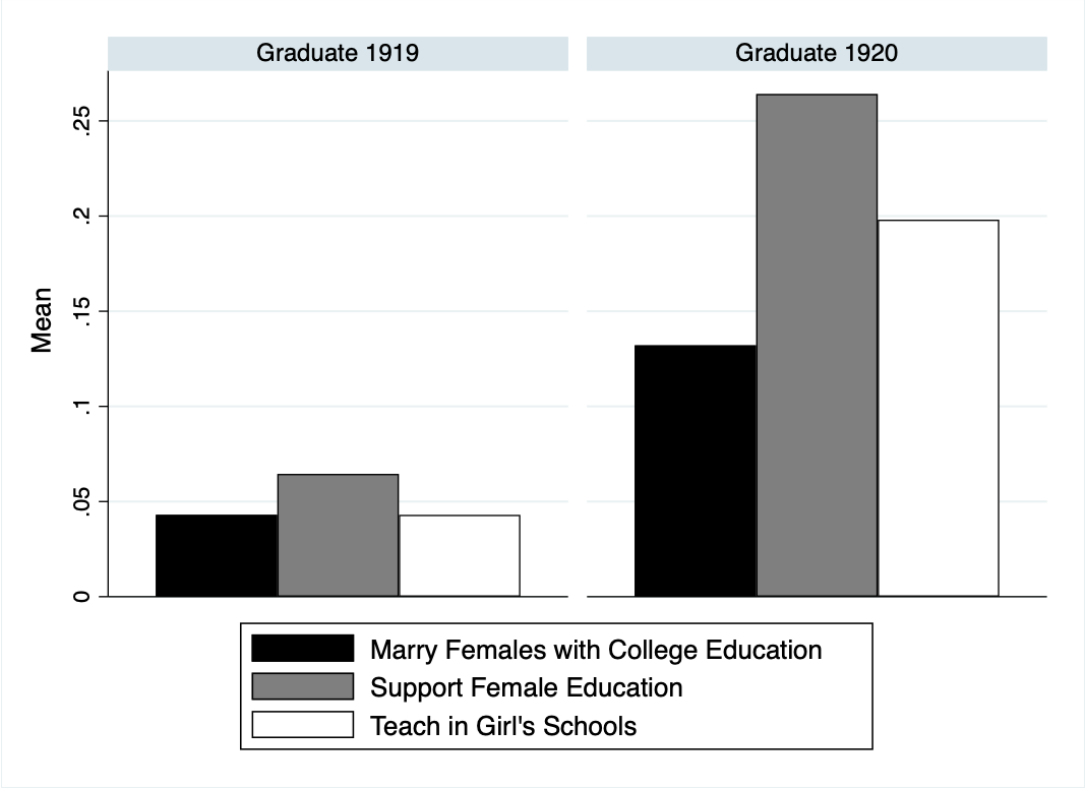
Notes: Figure A.4 shows the number of Chinese universities transitioned to coeducation in each year between 1920 and 1936.

Figure A.5: Dynamic Effects on Female Students in Chinese and Japanese Universities



Notes: Figure A.5 estimates equation (4) using county-year panel data that combines female Chinese students in Chinese and Japanese universities between 1915 and 1936, and reports the coefficients and 95% confidence intervals of *PKU Graduate* $1920_{ip} \times Year_t$.

Figure A.6: Male Students' Attitudes on Female Education



Notes: Figure A.6 shows the mean values of three proxies for male students' attitudes toward female education by year of graduation. Black denotes the mean of proxy on whether male students married women with college education. Grey denotes the mean of proxy on whether male students expressed support on female education publicly after the coeducation reform. White denotes the mean of proxy on whether male students taught in girls' schools after graduation.

Table A.1: Number of Schools and Students in 1917-1918

Level of Education	Type	Male	Female	Sex Ratio
Primary	Schools	116740	3363	34.71
	Students	3678736	164719	22.33
Secondary	Schools	834	98	8.51
	Students	103073	8005	12.88
Higher	Schools	84	0	-
	Students	19921	0	-

Note: Data is collected from Ministry of Education (1917).

Table A.2: Individual Balance Checks, Surname

	(1) Zhang	(2) Chen	(3) Li	(4) Wang	(5) Liu	(6) Yang	(7) Wu	(8) Zhou
PKU Graduate 1920	-0.0109	-0.0127	-0.0137	-0.0180	0.00265	0.00506	-0.00919	0.00755
	(0.0158)	(0.0158)	(0.0144)	(0.0146)	(0.0145)	(0.0116)	(0.0102)	(0.0111)
Observations	903	903	903	903	903	903	903	903
Mean of Dep. Variable	0.0642	0.0664	0.0487	0.0487	0.0432	0.0321	0.0244	0.0199
S.D. of Dep. Variable	0.245	0.249	0.215	0.215	0.203	0.176	0.154	0.140

Notes: Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. All regressions control for provincial fixed effects. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919.

Table A.3: Individual Balance Checks, Major at PKU

	(1) Humanities	(2) Law & Politics	(3) Science & Engineering	(4) Preparatory
PKU Graduate 1920	0.0414	-0.0261	-0.0402	0.0249
	(0.0278)	(0.0308)	(0.0322)	(0.0194)
Observations	903	903	903	903
Mean of Dep. Variable	0.224	0.315	0.373	0.0886
S.D. of Dep. Variable	0.417	0.465	0.484	0.284

Notes: Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. All regressions control for provincial fixed effects. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919.

Table A.4: Individual Balance Checks, Participation in Social Movements

	New Culture Movement			May Fourth Movement			
	(1) Social Group	(2) Writing Articles	(3) Combined	(4) Arrested	(5) Leader	(6) Writing Articles	(7) Combined
PKU Graduate 1920	0.0210	-0.0102	0.0195	-0.000607	0.00568	-0.00740	0.00114
	(0.0187)	(0.0106)	(0.0190)	(0.00569)	(0.00460)	(0.00711)	(0.00985)
Observations	903	903	903	903	903	903	903
Mean of Dep. Variable	0.0886	0.0266	0.0919	0.00775	0.00443	0.0111	0.0210
S.D. of Dep. Variable	0.284	0.161	0.289	0.0878	0.0664	0.105	0.144

Notes: Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. All regressions control for provincial fixed effects. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919.

Table A.5: Robustness Checks of Alternative Definitions

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Continuous Treatment	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
ln (1+Num. of PKU Graduate 1920)	0.141***	0.102***	0.155***	0.111***	0.366***	0.297***
	(0.0244)	(0.0243)	(0.0310)	(0.0302)	(0.103)	(0.0930)
Observations	5491	3723	5491	3723	2873	2414
Panel B. IHS Transformation	IHS(Number of Female University Students)		IHS(Number of Female University Students per 1 Million Women)			
PKU Graduate 1920	0.156***	0.150***	0.367***	0.429***		
	(0.0266)	(0.0337)	(0.0882)	(0.108)		
Observations	5491	3723	2873	2414		
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.6: Robustness Checks of Alternative Specifications

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Prefecture × Year FE						
PKU Graduate 1920	0.165***	0.140***	0.176***	0.147***	0.268*	0.322*
	(0.0336)	(0.0413)	(0.0391)	(0.0450)	(0.139)	(0.184)
Observations	5491	3723	5491	3723	2873	2414
Panel B. Exclude Overlapping Counties						
PKU Graduate 1920	0.0572***	0.0712***	0.0449***	0.0558***	0.120*	0.190***
	(0.0171)	(0.0204)	(0.0156)	(0.0186)	(0.0652)	(0.0651)
Observations	3519	2278	3519	2278	1751	1496
Panel C. Include Provincial Capitals						
PKU Graduate 1920	0.107***	0.107***	0.107***	0.109***	0.259***	0.322***
	(0.0185)	(0.0252)	(0.0195)	(0.0270)	(0.0692)	(0.0928)
Observations	5814	3893	5814	3893	3094	2567
Panel D. S.E. Clustered at Province × Year Level						
PKU Graduate 1920	0.121***	0.114***	0.121***	0.116***	0.295***	0.350***
	(0.0111)	(0.0152)	(0.0112)	(0.0161)	(0.0356)	(0.0552)
Observations	5491	3723	5491	3723	2873	2414
Panel E. Conley S.E.						
PKU Graduate 1920	0.121***	0.114***	0.121***	0.116**	0.295***	0.350***
	(0.0261)	(0.0356)	(0.0317)	(0.0458)	(0.0723)	(0.134)
Observations	5491	3723	5491	3723	2873	2414
Panel F. Control-restricted Subsample						
PKU Graduate 1920	0.130***	0.114***	0.131***	0.116***	0.292***	0.350***
	(0.0267)	(0.0238)	(0.0288)	(0.0261)	(0.0784)	(0.0879)
Observations	3723	3723	3723	3723	2414	2414
Panel G. GLM Models						
PKU Graduate 1920	0.7966***	0.9792***	0.9779***	0.8716***	2.0496***	2.3321***
	(0.1445)	(0.1898)	(0.1783)	(0.1795)	(0.5977)	(0.5761)
Observations	4327	2919	5491	3723	2873	2414
Estimation Method	Probit	Probit	Tobit	Tobit	Tobit	Tobit
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. Regressions in Panel B to G control for province-year fixed effects and regressions in Panel A control for prefecture-year fixed effects. Standard errors are clustered at county level in Panel A, B, C, F, and G. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.7: Robustness Checks of the Effects on Male Higher Education

	Dummy - Having Male University Students		ln (1+Number of Male University Students)		ln (1+Number of Male University Students per 1 Million Men)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920 × Post	0.00910	-0.0172	0.0255	-0.0164	-0.0746	-0.138
	(0.0320)	(0.0380)	(0.0377)	(0.0460)	(0.163)	(0.156)
Mean of Dep. Var.	0.2211	0.2211	0.2075	0.2075	0.6918	0.6918
Observations	10771	7304	10771	7304	5580	4723
County FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Post* is a dummy variable indicates the post-reform period. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.8: Robustness Checks with Matching Methods

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1) PSM	(2) NNM	(3) PSM	(4) NNM	(5) PSM	(6) NNM
ATE	0.4299***	0.7523***	0.4023***	0.7030***	0.3872***	0.6444***
	(0.0611)	(0.1159)	(0.0599)	(0.1113)	(0.0598)	(0.1068)
ATT	0.4331***	0.7438***	0.4065***	0.6981***	0.3888***	0.6361***
	(0.0654)	(0.1232)	(0.0621)	(0.1158)	(0.0623)	(0.1108)

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PSM* stands for propensity score matching, and *NNM* stands for nearest neighbor matching. Matching covariates include geographic controls of area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature, and land quality for agriculture; and social controls of population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.9: Robustness Checks of Regressions in Matched Samples

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Propensity Score Matching						
PKU Graduate 1920	0.111***	0.108***	0.113***	0.116***	0.298***	0.327***
	(0.0204)	(0.0215)	(0.0201)	(0.0223)	(0.0766)	(0.0784)
Observations	5355	3672	5355	3672	2822	2363
Weighted By Geo. Propensity Score	YES	YES	YES	YES	YES	YES
Panel B. Nearest Neighbor Matching						
PKU Graduate 1920	0.123***	0.120***	0.127***	0.123***	0.300***	0.393***
	(0.0228)	(0.0323)	(0.0254)	(0.0367)	(0.0870)	(0.131)
Observations	5355	3570	5355	3570	2720	2193
Matched Pair × Year FE	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.10: Effects on Female Higher Education, Alternative Cohorts

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. 1919 cohort vs. 1921 cohort						
PKU Graduate	0.104***	0.103***	0.104***	0.0999***	0.240***	0.277***
	(0.0175)	(0.0236)	(0.0184)	(0.0248)	(0.0668)	(0.0729)
Observations	6273	4284	6273	4284	3315	2839
Panel B. 1919 cohort vs. 1922 cohort						
PKU Graduate	0.105***	0.0949***	0.0993***	0.0922***	0.232***	0.278***
	(0.0167)	(0.0227)	(0.0169)	(0.0233)	(0.0627)	(0.0710)
Observations	8194	5440	8194	5440	4590	3689
Panel C. 1918 cohort vs. 1920 cohort						
PKU Graduate	0.0795***	0.0666***	0.0784***	0.0728***	0.215***	0.135**
	(0.0203)	(0.0243)	(0.0207)	(0.0261)	(0.0602)	(0.0604)
Observations	5457	3604	5457	3604	2975	2397
Panel D. 1917 cohort vs. 1920 cohort						
PKU Graduate	0.110***	0.0979***	0.113***	0.0992***	0.206***	0.231*
	(0.0201)	(0.0335)	(0.0211)	(0.0360)	(0.0701)	(0.129)
Observations	5100	3383	5100	3383	2771	2278
Panel E. 1918 cohort vs. 1921 cohort						
PKU Graduate	0.0676***	0.0731***	0.0648***	0.0753***	0.183***	0.155***
	(0.0198)	(0.0230)	(0.0205)	(0.0239)	(0.0563)	(0.0576)
Observations	6239	4165	6239	4165	3417	2822
Panel F. 1917 cohort vs. 1922 cohort						
PKU Graduate	0.0926***	0.0787***	0.0894***	0.0782**	0.159**	0.134
	(0.0175)	(0.0301)	(0.0168)	(0.0302)	(0.0618)	(0.0920)
Observations	7803	5100	7803	5100	4488	3553
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920 in Panel C and D, in 1921 in Panel A and E, and in 1922 in Panel B and F; and 0 when the county had no male PKU student who graduated in the aforementioned year but had at least one male PKU student who graduated in 1919 in Panel A and B, in 1918 in Panel C and E, and in 1917 in Panel D and F. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.11: Effects on Female Higher Education, Control for Post-reform Trends

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Spread of Information						
PKU Graduate 1920	0.121***	0.107***	0.121***	0.105***	0.295***	0.328***
	(0.0192)	(0.0238)	(0.0206)	(0.0262)	(0.0705)	(0.0922)
Observations	5491	3723	5491	3723	2873	2414
Panel B. Early Admitted Women (1920-1922)						
PKU Graduate 1920	0.0998***	0.0982***	0.0912***	0.0925***	0.241***	0.304***
	(0.0169)	(0.0222)	(0.0171)	(0.0241)	(0.0584)	(0.0797)
Observations	5491	3723	5491	3723	2873	2414
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.12: Effects of Other Major Universities in Beijing

	Tsing Hua University		Peking Normal University		Beiping University	
	(1)	(2)	(3)	(4)	(5)	(6)
Graduate 1920	0.0743	0.0266	0.0205	0.0318	0.0405	0.0371
	(0.0822)	(0.164)	(0.0393)	(0.0511)	(0.0351)	(0.0448)
Mean of Dep. Var.	0.0671	0.0671	0.0671	0.0671	0.0671	0.0671
Observations	765	663	1666	1224	2346	1598
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. The outcome variable is a dummy indicating whether the county having at least one female students being admitted to university. *Graduate 1920* is a dummy variable that equals 1 when a county had at least one male student of certain university who graduated in 1920; Otherwise, it indicates the county had no male student in that university who graduated in 1920 but had at least one male student in the same university who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.13: Effects of Other Coeducational Universities

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
Coedu Graduate	0.0803***	0.0772***	0.0791***	0.0839***	0.186***	0.199
	(0.00895)	(0.0237)	(0.00813)	(0.0196)	(0.0308)	(0.182)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	21510	12258	21510	12258	11106	8406
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. The sample used in this analysis contains all counties that had at least one male graduate from a coeducational university, and the estimation uses not-yet-treated counties as control group. *Coedu Graduate* is a dummy variable that equals 1 when a county had at least one male graduate of a coeducational university, and 0 otherwise. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.14: Effects on Female Higher Education, Staggered DID, Never-treated

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate	0.1669***	0.2311***	0.1509***	0.2125***	0.4458***	1.2539*
	(0.0125)	(0.0749)	(0.0120)	(0.0634)	(0.0556)	(0.6943)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	14340	8172	14340	8172	7404	5604
County FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. The sample used in this analysis contains all counties that had at least one PKU graduate during 1898-1948, and the estimation uses never-treated counties as control group. *PKU Graduate* is a dummy variable that equals 1 once a county had at least one male PKU graduate with coeducation experience (graduated between 1920 and 1936), and 0 otherwise. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.15: Effects on Female Higher Education, Difference-in-Differences Estimation

Outcomes: Female Chinese Students in Japanese Universities

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920	0.0175***	0.0207***	0.0142***	0.0161**	0.0426*	0.0437**
	(0.00571)	(0.00732)	(0.00518)	(0.00660)	(0.0224)	(0.0213)
Mean of Dep. Var.	0.0043	0.0043	0.0035	0.0035	0.0108	0.0108
Observations	11914	8066	11914	8066	6216	5217
County FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Post* is a dummy variable indicates the post-reform period. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.16: Effects on Male Students' Gender Attitudes: Full Sample

	Support Female Education	Marry Woman with College Education	Teach in Girls' Schools
	(1)	(2)	(3)
Panel A. Baseline			
Graduate 1920	0.0531***	0.0256**	0.0437***
	(0.0133)	(0.00999)	(0.0115)
Panel B. Heterogeneity of Majors			
Graduate 1920 × Same Major	0.151***	0.0736**	0.142***
	(0.0427)	(0.0353)	(0.0434)
Graduate 1920	0.0151	0.00644	0.00769
	(0.00974)	(0.00652)	(0.00702)
Same Major	0.0209	0.0254	0.0287
	(0.0155)	(0.0165)	(0.0179)
Mean of Dep. Variable	0.0377	0.0199	0.0288
Observations	903	903	903
Province FE	YES	YES	YES

Notes: Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. *Graduate 1920* is a dummy variable that equals 1 when a male PKU student was graduated in 1920, and 0 when the student was graduated in 1919. *Same Major* is a dummy variable that equals one if the student was in the same major as the first cohort of female students.

Table A.17: Heterogeneous Effects of Supply of Female Educational Opportunities

(*Num. Measure*)

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920 × Univ. Access	0.0593***	0.0639***	0.0624***	0.0689***	0.161***	0.216***
	(0.0111)	(0.0147)	(0.0128)	(0.0174)	(0.0438)	(0.0586)
PKU Graduate 1920	0.118***	0.110***	0.118***	0.112***	0.281***	0.330***
	(0.0190)	(0.0226)	(0.0203)	(0.0244)	(0.0678)	(0.0805)
Univ. Access	0.282	-0.127	0.243	-0.291	0.559	-0.742
	(0.340)	(0.332)	(0.427)	(0.409)	(1.315)	(1.217)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	5474	3723	5474	3723	2856	2397
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Univ. Access* is the sum of the number of universities admitting female students in all counties normalized by the great-circle distance. *Univ. Access* is normalized by the sample mean. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.18: Heterogeneous Effects of Labor Demand for Female Workers

(*Num. Measure*)

	Dummy - Having Female University Students		ln (1+Number of Female University Students)		ln (1+Number of Female University Students per 1 Million Women)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Modern Medical Institutes						
PKU Graduate 1920 × Demand-Med	0.0618***	0.0622***	0.0644***	0.0659***	0.166***	0.216***
	(0.0107)	(0.0143)	(0.0119)	(0.0161)	(0.0415)	(0.0551)
PKU Graduate 1920	0.116***	0.106***	0.114***	0.104***	0.274***	0.314***
	(0.0189)	(0.0227)	(0.0201)	(0.0242)	(0.0678)	(0.0827)
Demand-Med	-0.974*	-1.137***	-1.659***	-1.941***	-3.970***	-3.975***
	(0.508)	(0.409)	(0.635)	(0.469)	(1.360)	(1.309)
Panel B. Modern Firms						
PKU Graduate 1920 × Demand-Firm	0.0476***	0.0488***	0.0492***	0.0518***	0.128***	0.178***
	(0.00962)	(0.0128)	(0.0106)	(0.0141)	(0.0371)	(0.0515)
PKU Graduate 1920	0.119***	0.113***	0.119***	0.116***	0.280***	0.342***
	(0.0190)	(0.0236)	(0.0203)	(0.0261)	(0.0694)	(0.0834)
Demand-Firm	3.295***	1.324	3.868**	1.912	8.197*	5.059
	(1.226)	(1.062)	(1.651)	(1.365)	(4.262)	(4.640)
Mean of Dep. Var.	0.0671	0.0671	0.058	0.058	0.214	0.214
Observations	5474	3723	5474	3723	2856	2397
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Demand-Med* is the number of medical institutes in all counties normalized by the great-circle distance from these medical institutes to the county. *Demand-Firm* is the number of modern firms in all counties normalized by the great-circle distance from these firms to the county. Both *Demand-Med* and *Demand-Firm* are normalized by the sample mean. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.19: Effects on Female Junior Primary Education

	ln (1+Number of Female Students in Primary Schools)		ln (1+Number of Female Students in Primary Schools per 1 Million Women)	
	(1)	(2)	(3)	(4)
PKU Graduate 1920	0.1596	-0.3069	-0.0854	-0.2075
	(0.2282)	(0.2882)	(0.4570)	(0.6541)
Mean of Dep. Var.	5.4643	5.4643	7.8533	7.8533
Observations	249	169	133	110
Province FE	YES	YES	YES	YES
Geo. Controls		YES		YES
Social Controls		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.20: Effects on Female Teachers in Primary Education

	ln (1+Number of Female Teachers in Primary Schools)		ln (1+Number of Female Teachers in Primary Schools per 1000 Students)		ln (1+Number of Female Teachers in Primary Schools per 1000 Female Students)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920	0.1134	-0.3588	-0.1531	-0.2923*	-0.2349	-0.3334
	(0.2188)	(0.2575)	(0.1380)	(0.1510)	(0.2102)	(0.3117)
Mean of Dep. Var.	2.1024	2.1024	1.1031	1.1031	2.7993	2.7993
Observations	175	105	174	105	174	105
Province FE	YES	YES	YES	YES	YES	YES
Geo. Controls		YES		YES		YES
Social Controls		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

Table A.21: Effects on Gender-Related Popular Discourse, Robustness Checks

	Dummy - Establishment of Progressive Women's Periodicals		ln (1+Number of Articles on Progressive Women's Periodicals)		ln (1+Number of Edu-Related Articles on Women's Periodicals)	
	(1)	(2)	(3)	(4)	(5)	(6)
PKU Graduate 1920 × Post	0.00117*	0.00180	0.0318	0.0226	-0.000683	-0.00220
	(0.000660)	(0.00112)	(0.0212)	(0.0310)	(0.00266)	(0.00368)
Mean of Dep. Var.	0.0004	0.0004	0.051	0.051	0.0021	0.0021
Observations	11914	8066	11914	8066	11914	8066
County FE	YES	YES	YES	YES	YES	YES
Province × Year FE	YES	YES	YES	YES	YES	YES
Geo. Controls × Time Trend		YES		YES		YES
Social Controls × Time Trend		YES		YES		YES

Notes: Standard errors clustered at county level, * p<0.1, ** p<0.05, *** p<0.01. *PKU Graduate 1920* is a dummy variable that equals 1 when a county had at least one male PKU student who graduated in 1920, and 0 when the county had no male PKU student graduated in 1920 but had at least one male PKU student who graduated in 1919. *Post* is a dummy variable indicates the post-reform period. *Geo. Controls* include area, distance to the main rivers, distance to the coastline, distance to treaty ports, distance to provincial capital, rainfall, ruggedness, slope, temperature and land quality for agriculture. *Social Controls* include population density, the number of modern firms, modern banks, *Jinshi*, *Shengyuan* quota, and Christians. All control variables take the natural logarithmic form (plus one), and all social controls except population density are normalized by population before logarithmic transformation.

B Narratives on the Elite Network Effect of Male PKU Students with Coeducation Experiences

- Wang Lan, PKU Class of 1924:

  "I had been staying at home for one year after dropping out of high school ... My younger brother was studying at PKU and brought me many magazines to introduce the new thoughts about women's liberation and empowerment. My minds gradually changed and abandoned the restriction of traditional gender norms ... After realizing that PKU began to admit female students, I decided that I should give a try to pursue higher education." (Xu, 1920)

- Zha Xiaoyuan, PKU Class of 1924:

  "I learned from my cousin who was in PKU that female students were now allowed to study in PKU, and some girls had been admitted. So I decided to apply for PKU to pursue higher education."(Xu, 1920)

- Feng Yuanjun, PKU Class of 1925:

  "I went home from PKU for the summer vacation ... After hearing the news (of universities admitting women), my sister Feng Yuanjun who was in my hometown was determined to go to Beijing to take the entrance exam. At that time, my hometown was a remote area with a conservative atmosphere, and it was considered absurd for women to go to school. But Yuanjun was very brave, and our mother also rejected all kinds of criticism and supported Yuanjun to go. At the end of the summer vacation, Yuanjun went to Beijing together... In the end, she passed the entrance examination."(Feng, 1985)

- Luo Jialun, PKU Class of 1920:

  Luo Jialun, a male PKU graduate in 1920, was appointed the President of Tsinghua University in 1928. Despite other Chinese universities admitting female students after PKU, the prestigious Tsinghua University did not admit women until the late 1920s. After taking office, he promptly approved the proposal made by students and faculty to enroll female students, and in October 1928, Tsinghua University admitted its first class of female students (Zhang, 2007).