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Sex Discrimination and Female Top Managers: Evidence from China

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Abstract We examine whether sex discrimination contributes to the underrepresentation of female executives in large corporations. China's strong cultural preference for sons has made newborn boys greatly outnumber newborn girls. Using the male-to-female sex ratio at birth as the proxy for discrimination against women, we find that firms headquartered in more discriminatory areas hire fewer female executives. Even conditional on a woman reaching an executive position, she faces a higher likelihood of dismissal and receives lower compensation than her male counterparts. Overall, our findings suggest that sex discrimination plays an important role in preventing women from climbing the corporate ladder.

Keywords Sex discrimination · Female executives · Gender · Sex ratio · Executive compensation · Turnover · China

JEL Classification G30 · J71

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Introduction

Female executives are rare in large corporations around the world. For example, in 2012, although women comprise 47 % of the U.S. labor force and 51 % of management, professional, and related occupations, only 14 % of executive officers and 4 % of CEOs in Fortune 500 firms are women.[1] This underrepresentation is striking, especially because female corporate executives are usually found to be better decision makers (or at least no worse) than their male counterparts [see, for example, Dezso and Ross (2012), Huang and Kisgen (2013), and Liu et al. (2014a, b)]. Although a large number of studies conjecture that sex discrimination plays a role in preventing females from reaching top management positions (Becker 1971; Bertrand and Hallock 2001; Adams and Kirchmaier 2013),[2] there lacks of evidence, possibly because discrimination is usually illegal and thus companies have obvious incentives to keep discriminatory actions hidden.

In this paper, we employ a novel measure of sex discrimination and examine whether sex discrimination prevents females from climbing the corporate ladder. This question is important for at least three reasons. First, many firms are currently seeking to promote more women into senior management as the market competition challenges them to enhance the effectiveness of their human capital resources (Adler and Izraeli 1994; Oakley 2000). Second,

[1] Bureau of Labor Statistics 2012 Current Population Survey, and 2012 Catalyst Census: Fortune 500 Women Executives Officers and Top Earners.

[2] Other possible reasons include the difference in human capital skills, social norm, family consideration, risk attitudes, and psychological attribute regarding competition between male and female (Altonji and Blank 1999; Niederle and Vesterlund 2007; Bertrand et al. 2010).

the lack of women in the top management team has recently become an ethical issue and makes the firms subject to pressures from stakeholders for more visible participation of women in corporate decision-makings (Joecks et al. 2013). Third, reducing sex discrimination and promoting gender diversity in the workplace have gained considerable attention from the media and policy makers (Jones 1999; Meyer 1999). Therefore, better understanding the role of sex discrimination in the female underrepresentation in the top management team is meaningful for firms' human capital effectiveness and public image. Understanding this issue is also important for public policies that aim to promote gender diversity and women's positions in the labor market.

Our empirical analysis is based on a large sample of Chinese public firms, because China's data are particularly useful to this study. Unlike developed markets, such as the U.S. or Europe, discrimination against females is more severe and explicit in China due to social norms and weaker legal protection for women (OECD 2012; World Bank 2013). Moreover, compared to developed economies, there are greater variations in sex discrimination across different areas within China (Ebenstein 2011; Wei and Zhang 2011a), which allows us to implement within-country comparative studies. In addition, as of 2014, China is the second largest economy in the world; thus, understanding how corporate managers are selected in China is economically meaningful from a global perspective.

Our primary measure of sex discrimination is the newborn male-to-female ratio (hereafter referred to as sex ratio at birth). While the sex ratio at birth (left to nature) is generally around 100–105 boys per 100 girls due to human biology compensating for a slightly higher mortality rate for infant boys than infant girls, China has a significantly higher sex ratio at birth. According to the 2011 World Factbook published by the Central Intelligence Agency (see Appendix 1 for a partial list), China's sex ratio at birth in 2011 is 1.13, which is the highest figure across 228 countries in the world, followed by Armenia (1.12) and India (1.12). In contrast, this number in the European Union and the U.S. is 1.06 and 1.05, respectively. Such a high sex ratio at birth in China is attributed to sex-selective abortions and infanticide due to a strong preference for sons (Attané 2009; Scharping 2003; Zhu et al. 2009).

We use the province-level sex ratio at birth in China as a proxy of local discrimination against females and relate it to the representation of female managers in the top management team of local public firms. The sex ratio at birth statistic in each province is collectively determined by the birth-giving decisions of all parents in the area; therefore, it can be largely regarded as an exogenous variable to an individual public firm.

We expect firms in the provinces exhibiting stronger sex discrimination to have fewer female top managers for the following reasons. First, from the demand side of the labor market for top managers, the firms' employees and middle managers are probably pulled from local communities and thus are likely to resist hiring female top managers. Second, the firms' incumbent local top managers are also likely to be influenced by local gender preference and bias against female top managers. Third, even if the incumbent top managers are not local and have no discrimination against women, they may still avoid hiring female executives considering that having female executives may cause conflicts and resistance among employees, middle managers, and local top managers. Fourth, from the supply side of the labor market for top managers, qualified female candidates for top management positions may avoid working in areas with stronger gender discrimination, and in these areas, junior and middle-level female employees may have a lower chance for promotion, leading to an insufficient supply of female candidates for corporate executive positions. Fifth, in the presence of strong discrimination, local girls may possess less education and training (Coate and Laury 1993). The lack of human capital investment in the pre-labor market stage may further disadvantage females in climbing the corporate ladder after entering the labor market. Lastly, anticipating the occupational exclusion caused by discrimination in the selection process of top managers, talented women may avoid working as a professional manager in the first place (Altonji and Blank 1999). Overall, from both the demand and supply sides of the labor market for corporate executives, stronger discrimination against women should lead to fewer female top managers.

Consistent with the prediction above, we find that firms headquartered in the province with a higher sex ratio at birth (i.e., stronger discrimination against girls, or equivalently stronger preference towards boys) have a smaller proportion of female executives in the firms' top management teams. This relation is both statistically and economically significant and is robust across different subsamples. After controlling for various firm and province characteristics, including the contemporaneous supply of female labor force, we find that a 1 %-point decrease in newborn girls among all newborn infants is associated with a decrease in the percentage of female managers in local public firms by approximately 0.4 % points.

To further our understanding of how sex discrimination affects females in reaching top management positions, we examine new executive appointments and dismissals. We find that conditional on firms appointing a new executive, firms headquartered in more discriminatory provinces are less likely to appoint a female executive but are more likely to appoint a male one. However, conditional on firms firing an executive, we find that firms headquartered in more discriminatory provinces are more likely to fire a female manager than a male one. This finding is noteworthy,

because females who manage to overcome such discrimination and successfully achieve a top executive position should be especially capable and thus should face a lower likelihood of being fired. Overall, the lower likelihood of being appointed and the higher likelihood of being removed lead to a significantly negative relation between sex ratio at birth and the proportion of female executives in top management teams.

Moreover, conditional on a female reaching an executive position, sex discrimination also has an impact on her compensation. We find a significantly negative relation between sex ratio at birth and the gap in compensation between female executives and their male peers: female executives are paid significantly less than their male counterparts, especially in the provinces with more severe discrimination.

There could be a reverse causality issue: after observing successful women (i.e., women in top management positions of public firms), parents are less likely to abort girls, leading to a negative relation between sex ratio at birth and the prevalence of female top managers. We conduct two tests to investigate this possibility. First, given that we examine public firm data between 2000 and 2011, and that the earliest year with available province-level sex ratio figures is 1990, we use the sex ratio at birth figure in 1990 to replace the contemporaneous sex ratio at birth and our inferences are unchanged. Second, large firms are usually more influential than small firms. Therefore, under this reverse causality explanation, one should expect the negative relation between sex ratio at birth and the prevalence of female top managers to be more pronounced in large firms than in small firms. Opposite to this prediction, we find that the relation between sex ratio at birth and the prevalence of female top managers is more pronounced actually in small firms than in large firms, which is consistent with the view that small firms generally are more reliant on local market and thus are more sensitive to local gender bias. Overall, the reverse causality concern is unlikely to drive our results.

To further alleviate the concern that some unobserved factors are driving our results, we implement a change analysis. We find that, over our sample period, the provinces with a greater decrease in sex ratio at birth experience a greater increase in the female representation in top management.

We also extend our analysis of female representation in top management to firms' board of directors. We also find a negative association between sex ratio at birth and the prevalence of female directors on the board, indicating that sex discrimination prevents females not only from reaching top management positions, but also from joining the board.

In summary, our paper provides supporting evidence that discrimination against women is an important factor leading to the underrepresentation of female top managers in large corporations.

The paper is organized as follows. We review the literature in the following section. Section 3 describes the data and key variable construction. Section 4 presents the empirical results on the relation between sex discrimination and the representation of female top managers. Finally, we conclude the paper in Sect. 5 with a brief summary.

Related Literature

Our study is related to the research in three areas: the social and economic implications of sex ratio, gender discrimination in the labor market, and the differences in corporate decisions made by male and female executives.

First, there is an increasing interest in the implication of a high sex ratio imbalance on status goods and social norms among economists. Wei and Zhang (2011a, b) find that when there is a great surplus of men in the pre-marital age cohort, parents of a son, or sons themselves are more eager to do something to improve their standing in the marriage market by raising their savings, inducting more entrepreneurship activities, supplying more labor, and becoming more willing to take unpleasant jobs for a higher expected pay. On the other side, Edlund et al. (2013) find a positive association between sex ratio of 15–25-year olds and crime rates: when young men cannot find wives, they commit more crimes. Our contribution to this strand of literature is twofold. First, these studies typically examine the sex ratio of adults, while our study focuses on the sex ratio of infants. Our evidence suggests that these two sex ratios have different implications: while the former has a significant influence on the marriage market, the latter reflects sex discrimination and affects women's career path. Second, although these prior studies enhance our understanding of how sex ratio affects individuals' decision-making, the influence of sex ratio on corporate decisions is less examined. Our study fills this gap by showing that sex ratio at birth plays a significant role in the corporate decisions of promoting females into the top management team.

Second, there is also substantial literature about sex discrimination in the labor market [see Bertrand et al. (2010), (Fryer 2011), and Charles and Guryan (2011) for excellent reviews]. Due to a lack of explicit observations of discrimination, economists typically measure sex discrimination in the labor markets indirectly by estimating the male–female wage differentials that are not attributable to observable differences in the human capital of workers [see, for example, Blinder (1973), Oaxaca (1973), and Mincer and Polachek (1974)]. As pointed out by Kuhn (1987), this method is an ex post one (i.e., after selecting the women into the job positions), and it fails to account for

the discrimination in selecting women into job positions in the first place. Filling this gap in the literature, our discrimination measure is an ex ante one (i.e., before selecting the women into the job positions), and we provide evidence that sex discrimination not only influences the women's compensation after they become corporate executives, but also prevents women from reaching top management positions in the first place.[3]

Lastly, our study is also related to the surging literature on how male and female executives differ in making corporate decisions. Huang and Kisgen (2013) find that acquisitions made by female executives have a higher announcement return than those made by male executives, and they interpret this finding as female executives being less overconfident than their male counterparts. Faccio et al. (2014) find that firms run by female CEOs have a higher chance of survival than firms run by male CEOs. In the banking industry, Beck et al. (2013) show that loans handled by female loan officers have a lower likelihood to turn problematic than those handled by male loan officers. From the perspective of board of directors, Adams and Ferreira (2009) document that having females on the board usually improves board effectiveness. Moreover, firms with greater female participation on their boards are found to exhibit higher earnings quality and have better informativeness of stock prices (Gul et al. 2011; Srinidhi et al. 2011). In the context of acquisitions, Levi et al. (2014) find that acquiring firms with female directors on the board are less likely to overpay the target firms. Research based on Chinese data also finds similar results. For example, Liu et al. (2014a) analyze a sample of China's public firms and find that female CFOs engage in less earning manipulation and have higher financial reporting quality than male CFOs. Liu et al. (2014b) show that, in China, female executive directors have a significant positive effect on firm performance. Zeng and Wu (2012) find that female executives in China have a positive effect on firm innovation. Although these studies enhance our understanding of gender difference in corporate decision-making, none of them investigates why so few women are in top management positions, even when their decision-making skills are no worse than their male peers'.

Sample

Our primary measure of discrimination is the province-level boy-to-girl sex ratio at birth statistic, obtained from population census surveys in 2000, 2005, and 2010, conducted by the Chinese National Statistics Bureau.[4] The total number of each gender born in the 12-month period around the survey dates was recorded for each province. Our sample firms are the ones listed in the Shanghai and Shenzhen stock exchanges from 2000 to 2011, obtained from the CSMAR database. We start in 2000 because the CSMAR database starts to record detailed executive information from 2000. Similar to the U.S., executive positions in China typically include CEO, CFO, COO, Vice President, etc. Given that the sex ratio data are available every 5 years, for each firm-year observation, we obtain the province-level sex ratio at birth in the firm's headquarter in the closest prior year.[5] That is, we apply the 2000, 2005, and 2010 survey information to the 2000–2004, 2005–2009, and 2010–2011 sample period, respectively. Our final sample consists of 13,624 firm-year observations over the 2000–2011 period. We winsorize all continuous variables at the 1st and 99th percentiles and convert all Chinese Yuan values to 2011 U.S. dollars.[6] Detailed definitions of the variables are presented in Appendix 2.

Panel A of Table 1 presents the summary statistics of sample firms. In the median firm, only 10 % of top management positions are held by women (i.e., the ratio of male executives to female executives is close to 9), while the median ratio of male workers over female workers in the labor force is 1.216, and the median ratio of males with college education over females with college education is 1.325. Clearly, the underrepresentation of female top managers cannot be fully explained by the difference in participation in the labor market or the difference in education level in the overall population. Moreover, the median sample firm is 8 years old and has total assets of $287 million. Further, it performs well with an ROA of 3.42 % and a market-to-book ratio of 1.325.

Panel B of Table 1 presents the correlation matrix among independent variables. It is worth pointing out that sex ratio at birth is negatively associated with sex ratio in labor force with a correlation coefficient of −0.29, but is positively associated with sex ratio with college degree with a correlation coefficient of 0.37. This finding suggests that in

[3] Instead of examining the wage difference between males and females, Kuhn and Shen (2013) study explicit gender discrimination in a population of advertisements on a Chinese Internet job board and find that gender-targeted job advertisements are common.

[4] The Chinese National Statistics Bureau usually conducts the population censure surveys every 5 years, and thus, there are three surveys in the 2000–2010 period. We use the province-level data on sex ratio at birth mainly because the finest granularity of this information is at the province level.

[5] Sex ratio at birth shows few changes over time. For example, the correlation coefficient between sex ratio at birth in 2000 and sex ratio at birth in 2010 is 0.75. This fact is consistent with our argument that sex ratio at birth reflects parents' preference for sons, which changes very slowly over time. In an untabulated sensitivity test, we employ the sex ratio data from the closest year instead of the closest prior year, and our inference is unchanged.

[6] Chinese Yuan is converted to U.S. dollars based on an exchange rate of one U.S. dollar to seven Chinese Yuan.

Table 1 Summary statistics

	Mean	Std	P25	Median	P75
Panel A: Characteristics of sample firms					
Percentage of female executives (%)	12.03	14.17	0.00	10.00	20.00
Sex ratio at birth	1.163	0.070	1.118	1.148	1.213
Sex ratio in labor force	1.257	0.129	1.159	1.216	1.337
Sex ratio with college degree	1.382	0.300	1.185	1.325	1.533
GDP per capita	3237	2401	1527	2481	4100
Firm age	8.111	4.129	5.000	8.000	11.000
Total assets ($ millions)	760	1854	157	287	600
ROA (%)	3.12	7.22	1.09	3.42	6.30
M/B	1.638	0.918	1.077	1.325	1.831
Stock volatility (%)	13.90	4.89	9.94	13.18	17.23

	1	2	3	4	5	6	7	8	9
Panel B: correlation matrix									
1 Sex ratio at birth	1								
2 Sex ratio in labor force	–0.29 (0.00)	1							
3 Sex ratio with college degree	0.37 (0.00)	–0.44 (0.00)	1						
4 Ln (GDP per capita)	–0.21 (0.00)	0.46 (0.00)	–0.54 (0.00)	1					
5 Firm age	–0.02 (0.02)	0.09 (0.00)	–0.28 (0.00)	0.36 (0.00)	1				
6 Ln(total assets)	–0.05 (0.00)	0.13 (0.00)	–0.19 (0.00)	0.26 (0.00)	0.15 (0.00)	1			
7 ROA	–0.01 (0.35)	0.02 (0.01)	–0.03 (0.00)	0.09 (0.00)	–0.11 (0.00)	0.18 (0.00)	1		
8 M/B	–0.03 (0.00)	0.03 (0.00)	–0.09 (0.00)	0.12 (0.00)	0.13 (0.00)	–0.32 (0.00)	0.13 (0.00)	1	
9 Stock volatility	–0.01 (0.22)	0.05 (0.00)	–0.20 (0.00)	0.27 (0.00)	0.34 (0.00)	0.01 (0.16)	–0.01 (0.40)	0.36 (0.00)	1

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. In Panel B, p values of the correlation coefficients are reported in parentheses. The variable definitions are provided in Appendix 2

provinces with stronger sex discrimination, girls (as compared to boys) have poorer opportunities for college and tend to enter the labor market at a younger age. The fact that these coefficients are relatively small in magnitude is not surprising, given that there is around a 20-year lag for an infant to obtain a college degree and enter the labor market, and that families may move from one province to another during this 20-year period. Moreover, none of the correlations among firm characteristics is high enough to warrant multicollinearity concerns for our multivariate analyses.

As shown in Table 2, the average sex ratio at birth is 1.163 in China, indicating that there is severe discrimination against females.[7] More importantly, there is great variation in this ratio across different provinces in China. The top three provinces with the highest sex ratios at birth are Anhui (1.291), Hainan (1.280), and Hubei (1.270), while the three provinces with the lowest sex ratios at birth are Ningxia (1.098), Xinjiang (1.057), and Tibet (1.045).[8] The most economically developed areas

[7] Assuming that the global benchmark of sex ratio at birth is 1.05, a t test of the null of the sex ratio at birth being 1.05 is rejected at the 1 % level.

[8] The fact of lower sex ratio in these three provinces is largely consistent with the existing literature that China's sex discrimination is less severe in less developed areas and in the areas with smaller Han ethnic population. For example, Attané (2009) finds that, in China, the provinces with greater economic and social modernization tend to have more severe gender discrimination. Attané (2009, p. 98) states that "...far form reducing discrimination against daughters, modernization actually tends to increase it." Moreover, Ningxia, Xinjiang, and Tibet are dominated by non-Han ethnic population. Compared to the Han ethnic group, non-Han ethnic groups are less prone to practice gender discrimination (Banister 2004).

Table 2 Sex ratio at birth and percentage of female executives across provinces

Province	Sex ratio at birth	# of firm-year observations	Percentage of female executives (mean) (%)	Industry-average-adjusted percentage of female executives (mean) (%)
Anhui (安徽)	1.291	435	9.47	−0.29
Hainan (海南)	1.280	191	11.64	0.32
Hubei (湖北)	1.270	617	10.23	−1.55
Hunan (湖南)	1.236	420	9.17	−1.31
Shaanxi (陕西)	1.235	251	10.53	0.05
Guangdong (广东)	1.232	1,588	12.24	0.23
Guangxi (广西)	1.230	211	9.32	−2.14
Fujian (福建)	1.218	431	11.38	−1.73
Jiangxi (江西)	1.211	213	6.11	−4.34
Jiangsu (江苏)	1.190	878	11.08	−1.39
Guizhou (贵州)	1.179	141	10.93	1.04
Henan (河南)	1.172	327	7.56	−1.94
Hebei (河北)	1.161	327	8.48	−1.76
Gansu (甘肃)	1.157	290	13.40	2.68
Shandong (山东)	1.152	781	10.24	−0.05
Zhejiang (浙江)	1.152	884	13.24	0.17
Sichuan (四川)	1.142	638	9.85	−0.94
Tianjian (天津)	1.136	212	13.72	1.09
Chongqing (重庆)	1.133	278	14.75	2.34
Qinghai (青海)	1.130	94	13.07	4.24
Shanghai (上海)	1.130	1,465	14.68	2.73
Shanxi (山西)	1.130	226	6.34	−1.77
Neimenggu (内蒙古)	1.120	171	9.19	0.98
Liaoning (辽宁)	1.118	488	12.07	0.36
Jilin (吉林)	1.116	308	14.25	1.27
Beijing (北京)	1.112	917	13.31	1.24
Yunnan (云南)	1.109	231	10.71	0.25
Heilongjiang (黑龙江)	1.106	251	11.09	0.22
Ningxia (宁夏)	1.098	5	9.09	1.73
Xinjiang (新疆)	1.057	274	16.60	5.83
Tibet (西藏)	1.045	81	16.60	7.76
Full sample	1.163	13,624	11.68	–

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. All continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The Chinese names of the provinces are provided in parentheses

(such as Beijing, Shanghai, and Guangdong) are in the middle of the list.[9] Column (4) of Table 2 presents the percentage of female executives in firms headquartered in the corresponding provinces. In the last column, to account for the difference in industry distribution across different provinces, we compute the industry-average-adjusted percentage of female executives and find a clear pattern that the industry-adjusted percentage of female executives is typically negative when the sex ratio at birth is high and becomes positive when the sex ratio at birth is low.

In Fig. 1 Panel A, we split our sample based on the median sex ratio at birth and plot the time-series pattern of

[9] Although son preference is the fundamental driving force for the imbalanced sex ratio at birth, the regional variation in sex ratio at birth may also be partially driven by the enforcement of the one-child policy and the availability of sex-selective abortion technology (i.e., Ultrasound B) in different provinces. To the extent that an individual firm's choice of having female executives has little to do with the one-child policy or Ultrasound B technology, this possibility works against us finding any significant results between sex ratio at birth and female representation in the top management team.

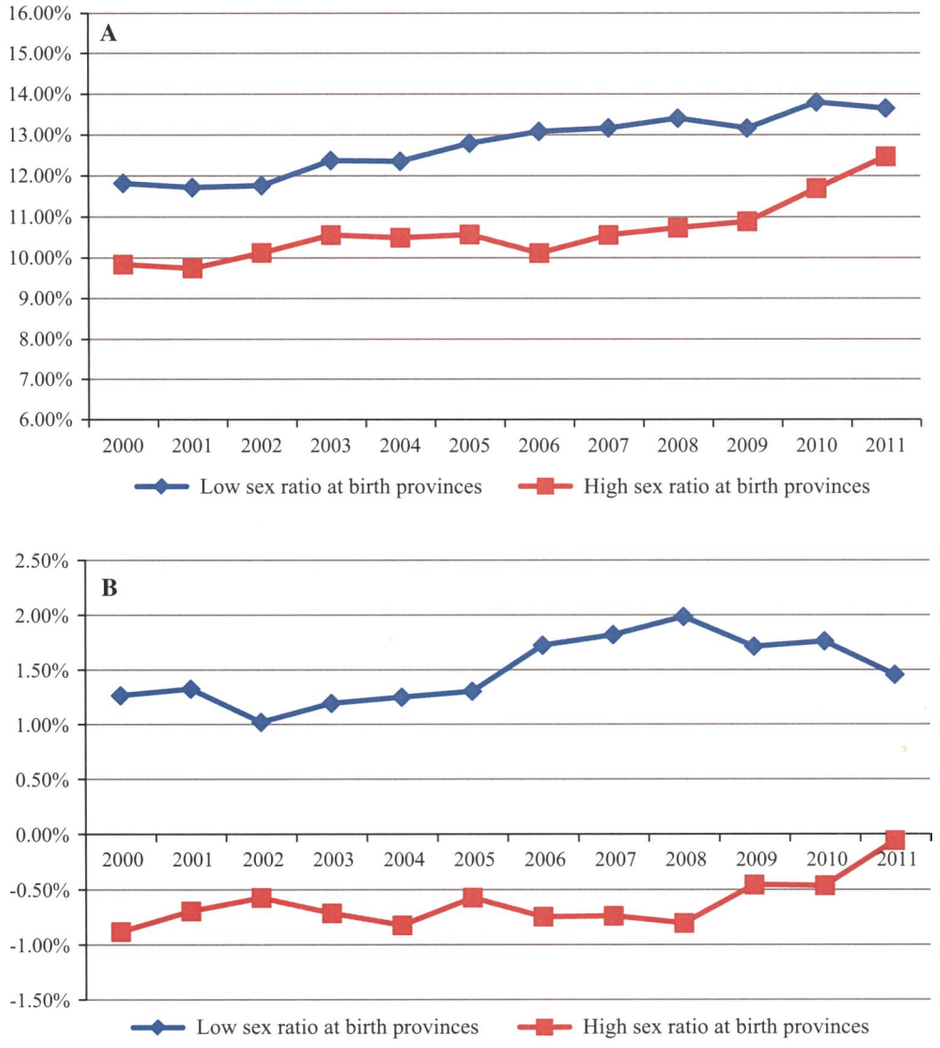

Fig. 1 Percentage of female executives over time. The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The high (low) sex ratio at birth provinces is categorized based on the sample median value of sex ratio at birth. **a** Percentage of Female Executives (mean). **b** Industry-average-adjusted percentage of female executives (mean)

the percentage of female executives. In each year of our sample, firms in areas with a high sex ratio at birth have fewer female executives than the ones in areas with a low sex ratio at birth. This difference is quite stable over the entire sample period, while both types of firms experience a modest increasing trend in the percentage of female executives. In Panel B, we plot the industry-average-adjusted percentage of female executives (the difference between a firm's percentage of female executives and the industry-average value) and see similar patterns.

Table 3 presents the distribution of percentage of female executives across industries based on the industry classification from the Chinese Securities Regulatory Commission. The top three industries with most female executives are wholesale and retail (20.62 %), textile and apparel (20.48 %), and pharmaceuticals (15.55 %). As expected, construction, metals and non-metals, and mining are the three industries with the fewest female executives, with the percentage of female executives being 8.11, 7.18, and 5.56 %, respectively. This finding is broadly consistent with prior literature, which shows that female executives are more prevalent in service-

oriented or women's products industries than in mining and manufacturing industries (Harrigan 1981; Fryxell and Lerner 1989; Bertrand and Hallock 2001).

Empirical Results

Percentage of Female Executives

We estimate the following ordinary least squares (OLS) regression to examine whether discrimination against women is related to the proportion of female executives in firms' top management teams:

$$\begin{aligned}\text{Percentage of female executives} = {} & \alpha + \beta_1 \text{Sex ratio at birth} + \beta_2 Ln(\text{total assets}) + \beta_3 \text{Firm age} + \beta_4 M/B + \beta_5 ROA \\ & + \beta_6 \text{Stock volatility} + \beta_7 Ln(\text{GDP per capita}) + \beta_8 \text{Sex ratio with college degree}. \\ & + \beta_9 \text{Sex ratio in labor force} + \text{Industry FEs} + \text{Year FEs} + \varepsilon \end{aligned} \quad (1)$$

In Column (1) of Table 4 Panel A, we only include *Sex ratio at birth* and industry and year fixed effects in the regression; the coefficient on *Sex ratio at birth* is −14.448 and is significant at the 1 % level. Further controlling for firm size in Column (2), the coefficient on *Sex ratio at birth* is −15.417 and is still significant at the 1 % level. We then control for firm age, market-to-book (M/B) ratio, ROA, and stock return volatility in Column (3) and still obtain a significant and negative coefficient on *Sex ratio at birth*. In Column (4), we include a few province characteristics. In particular, we use GDP per capita to control for the economic development, and use the ratio of the number of men with college degree over the number of women with college degree (sex ratio with college degree) and the ratio of the number of men in the labor force over the number of women in the labor force (sex ratio in labor force) to account for the overall labor market supply of men and women. The coefficient on *Sex ratio at birth* is −10.625 and is still significant at the 1 % level. The economic magnitude of this coefficient is also sizeable: a 1 % decrease in newborn girls among all newborn babies from 50 % (the corresponding sex ratio at birth is 1:1 in this case) to 49 % (the corresponding sex ratio at birth is 1.04:1) is associated with a decrease in the percentage of female executives by 0.425 % [=(1.04 − 1) × 10.625 %)].

Moreover, consistent with the view that firms facing less product market competition are more likely to discriminate (Ashenfelter and Hannan 1986; Kuhn and Shen 2013), large firms have a lower percentage of female executives. Firms in more developed provinces (higher GDP per capita) are found to have more female executives, consistent with (Adams and Kirchmaier 2013) finding that country-level income per capita is positively related to female director representation on the board. The coefficients on the ratio of men over women with a college education and the ratio of men over women in the labor force are not significantly different from zero, indicating that firms' candidate pool for top managers is different from the general labor force. It is also worth noting that the *Sex ratio at birth* variable measures the contemporaneous ratio of infant boys over infant girls, which has no direct effect on the contemporaneous labor market pool for corporate executives. Thus, after controlling for the contemporaneous male-to-female ratio in the labor force, the effect of *Sex ratio at birth* on the proportion of female executives is not because there are simply more men than women in the labor market.[10]

In Panel B, we conduct various subsample analyses to further our understanding of how local discrimination influences the prevalence of female executives in a firm. First, the selection of top management, especially CEOs, in Chinese state-owned enterprises (SOEs) is greatly influenced by the central government (Qian 1996; Chang and Wong 2004). For this reason, the association between local discrimination and percentage of female executives may be weaker in SOEs than in non-SOEs. On the other hand, Kuhn and Shen (2013) find that sex discrimination is more severe in Chinese SOEs than in non-SOEs, because SOEs typically face less product market competition. Thus, a priori, it is not clear whether the sex ratio at birth variable influences the presence of female top managers in a different way across these two types of firms. Based on the firms' ultimate controlling shareholders, we classify firms into the SOEs controlled by the central government, the SOEs controlled by the local government, and non-SOE public firms. In Columns (1–3), we separately examine these three types of firms, respectively. We find that the coefficients on *Sex ratio at birth* are negative and

[10] Moreover, as reported in Panel B of Table 1, sex ratio at birth is negatively correlated with sex ratio in the labor force, which further mitigates the concern that our results are driven by the fact that there are more men than women in the labor force in the provinces with high sex ratio at birth.

Table 3 Percentage of female executives across industries

Industry	# Of firm-year observations	Average percentage of female executives (%)
Wholesale and retail trade	1023	20.62
Textiles and apparel	426	20.48
Pharmaceuticals	882	15.55
Real estate	1107	15.36
Comprehensive	525	14.41
Information technology	711	13.10
Other manufacturing	90	12.96
Finance and insurance	165	12.80
Agriculture, forestry, livestock farming, fishery	252	12.78
Communication and cultural Industry	175	12.72
Social services	437	11.89
Paper and printing	236	11.30
Food and beverage	621	11.06
Timber and furnishings	25	11.03
Utilities	642	10.55
Electronic	522	10.34
Transportation	544	9.75
Petrochemicals	1412	8.52
Machinery	2019	8.44
Construction	246	8.11
Metals and non-metals	1179	7.18
Mining	385	5.56
Full sample	13,624	11.68

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. All continuous variables are winsorized at the 1st and 99th percentiles. The classification of industries is defined by China Securities Regulatory Commission. The variable definitions are provided in Appendix 2

significant in all the three columns. The corresponding Chow test on the equality of these coefficients indicates no significant difference, implying that the influence of local discrimination on the prevalence of female top managers is similar across these three types of firms.

Second, the construction, metals and non-metals, and mining industries are typically regarded as men-dominated industries, in which the executive positions are held by the lowest percentage of women in our sample. To examine whether the effect of *Sex ratio at birth* on the proportion of female executives varies across different industries, we further divide our sample into men-dominated industry and non-men-dominated industry and re-estimate Eq. 1 based on the two subsamples, respectively. As shown in Columns (4) and (5), the coefficients on *Sex ratio at birth* are around a significant −10 in both columns, indicating

Table 4 Gender discrimination and percentage of female executives

	(1)	(2)	(3)	(4)
Panel A: full sample analysis				
Sex ratio at birth	−14.448*** (0.000)	−15.417*** (0.000)	−15.106*** (0.000)	−10.625*** (0.008)
Ln (total assets)		−1.264*** (0.000)	−1.320*** (0.000)	−1.447*** (0.000)
Firm age			0.162** (0.028)	0.149** (0.042)
M/B			0.203 (0.473)	0.169 (0.549)
ROA			3.334 (0.195)	2.962 (0.246)
Stock volatility			−9.115 (0.139)	−8.979 (0.143)
Ln (GDP per capita)				1.086* (0.075)
Sex ratio with college degree				−1.416 (0.166)
Sex ratio in labor force				−0.229 (0.931)
Constant	30.137*** (0.000)	55.456*** (0.000)	55.997*** (0.000)	47.517*** (0.000)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R^2	8.5 %	9.3 %	9.4 %	9.6 %
No. of observations	13,624	13,624	13,624	13,624

Table 4 continued

	(1) Central SOE	(2) Local SOE	(3) Non-SOE	(4) Men-dominated Industry	(5) Non-men-dominated Industry	(6) 2000–2005 period	(7) 2006–2011 period	(8) Excluding Shanghai and Guangdong	(9) Excluding Xinjiang and Tibet	(10) Excluding Firms that Changed Location
Panel B: subsample analysis										
Sex ratio at birth	−14.664*** (0.001)	−10.524** (0.039)	−15.353** (0.044)	−10.332* (0.080)	−10.556** (0.039)	−7.068** (0.018)	−14.722*** (0.004)	−15.533*** (0.001)	−6.189*** (0.003)	−10.342** (0.012)
Ln (total assets)	−0.686*** (0.004)	−0.991*** (0.009)	−1.560*** (0.001)	−1.311*** (0.000)	−1.490*** (0.000)	−1.211*** (0.000)	−1.455*** (0.000)	−1.320*** (0.000)	−1.490*** (0.000)	−1.423*** (0.000)
Firm age	−0.048 (0.510)	0.213* (0.070)	0.150 (0.158)	0.099 (0.423)	0.165* (0.069)	0.323*** (0.000)	0.079 (0.296)	0.172** (0.049)	0.171*** (0.000)	0.155** (0.039)
M/B	0.142 (0.717)	0.630 (0.116)	−0.174 (0.687)	0.062 (0.899)	0.213 (0.533)	−0.235 (0.554)	0.310 (0.312)	0.022 (0.940)	0.087 (0.642)	0.202 (0.498)
ROA	10.147** (0.016)	3.685 (0.280)	−3.476 (0.375)	1.472 (0.734)	3.426 (0.265)	5.692** (0.033)	1.020 (0.749)	1.403 (0.631)	4.115** (0.025)	3.427 (0.213)
Stock volatility	10.116 (0.197)	−14.590 (0.103)	−13.735 (0.149)	−1.173 (0.913)	−11.892 (0.114)	−20.011*** (0.000)	−0.753 (0.928)	−14.683** (0.024)	−9.648*** (0.006)	−7.780 (0.207)
Ln (GDP per capita)	−1.221** (0.011)	2.270*** (0.007)	−0.505 (0.638)	1.468 (0.113)	0.937 (0.227)	1.325*** (0.000)	0.768 (0.276)	−0.261 (0.724)	1.413*** (0.000)	1.241** (0.050)
Sex ratio with college degree	−1.427 (0.386)	−2.342* (0.055)	−0.187 (0.922)	1.004 (0.543)	−2.463* (0.053)	−2.484*** (0.008)	−0.653 (0.563)	−1.664 (0.110)	−0.763 (0.232)	−1.412 (0.179)
Sex ratio in labor force	1.673 (0.496)	−3.098 (0.368)	5.072 (0.271)	0.541 (0.892)	−0.552 (0.871)	−2.977 (0.108)	1.261 (0.654)	−0.421 (0.878)	0.411 (0.726)	−0.921 (0.739)
Constant	41.044*** (0.000)	34.053*** (0.005)	60.585*** (0.000)	29.772** (0.022)	51.526*** (0.000)	43.000*** (0.000)	52.910*** (0.000)	62.216*** (0.000)	38.761*** (0.000)	45.979*** (0.000)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2 (%)	9.9	11.9	7.6	2.7	8.0	9.3	10.2	11.4	9.7	9.9
No. of observations	2120	7433	4071	3829	9795	5688	7936	10,571	13269	12,809

	(1) Adjust for industry	(2) Adjust for education	(3) Adjust for labor participation
Panel C: alternative measure of female executives representation			
Sex ratio at birth	−11.042*** (0.005)	−12.679*** (0.001)	−10.300*** (0.009)
Ln (total assets)	−1.091*** (0.000)	−1.441*** (0.000)	−1.449*** (0.000)
Firm age	0.107 (0.135)	0.147** (0.045)	0.150** (0.042)
M/B	0.205 (0.474)	0.169 (0.550)	0.169 (0.549)
ROA	2.550 (0.320)	2.887 (0.259)	2.982 (0.242)
Stock volatility	−6.650 (0.277)	−8.803 (0.151)	−8.984 (0.143)

Table 4 continued

	(1) Adjust for industry	(2) Adjust for education	(3) Adjust for labor participation
Ln (GDP per capita)	0.837 (0.140)	1.164* (0.054)	1.019* (0.070)
Sex ratio with college degree	−1.401 (0.168)		−1.283 (0.214)
Sex ratio in labor force	−0.247 (0.925)	0.753 (0.773)	
Constant	30.404*** (0.000)	45.159*** (0.000)	47.961*** (0.000)
Year FE	Yes	Yes	Yes
Industry FE	No	Yes	Yes
Adjusted R^2	1.3 %	9.7 %	9.6 %
No. of observations	13,624	13,624	13,624

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. In Panels A and B, the dependent variable is the percentage of female executives in the firm's top management team (measured in percentage points). In Panel C Column (1), the dependent variable is the industry-average-adjusted percentage of female executives, defined as the percentage of female executives—the industry-average percentage of female executives (measured in percentage points). In Panel C Column (2), the dependent variable is the education-adjusted percentage of female executives, defined as the percentage of female executives—the number of women as a percentage of total number of people with college degree in that province (measured in percentage points). In Panel C Column (3), the dependent variable is the labor-adjusted percentage of female executives, defined as the percentage of female executives—the number of women as a percentage of the total number of people in the labor force in that province (measured in percentage points). Sex ratio at birth is the ratio of newborn boys over newborn girls. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2

The symbols ***, **, and * denote significance at the 1, 5, and 10 % levels, respectively. *P* values based on robust standard error clustered at the firm level are reported in parentheses

that the effect of local gender discrimination on female executive representation is as strong in men-dominated industries as in other industries.

Third, Fig. 1 suggests that there is an increasing trend in the percentage of female executives for both high and low sex ratio at birth provinces, and the difference between the two groups seems narrowed since 2010. It may raise concerns that our findings might be driven by the earlier sample period. To investigate this possibility, we split our sample into the early period (2000–2005) and the late period (2006–2011) in Columns (6) and (7), respectively. We find negative and significant coefficients on *Sex ratio at birth* in both periods. Thus, our findings are unlikely to be driven by some particular time periods.

Fourth, Shanghai and Guangdong (where the Shanghai Stock Exchange and the Shenzhen Stock Exchange are located, respectively) have the largest number of firms in our sample. To investigate whether our results are driven by these two places, we exclude Shanghai and Guangdong and re-estimate Eq. 1. As reported in Column (8), the coefficient on *Sex ratio at birth* is still negative and significant.

Moreover, Xinjiang and Tibet have the highest percentage of female executives, and their industry-average-adjusted percentage of female executives is far higher than other provinces. To examine the possibility that our results are mainly driven by these two provinces, we exclude the firms from these provinces in Column (9), and we continue to find a negative and significant coefficient on *Sex ratio at birth*.

Lastly, although public firms seldom move their headquarters (Pirinsky and Wang 2006; Deng and Gao 2013), it may be less accurate to identify a firm's local gender preference if the firm frequently changes its headquarters. In our sample, 99 firms relocated their headquarters during our sample period.[11] As a robustness check, in Column (10), we exclude these firms from the sample and re-estimate Eq. 1. The *Sex ratio at birth* variable still attracts a negative and significant coefficient.

In Panel C, we employ several alternative methods to capture the female executive representation in a firm. In Column (1), to further account for the industry effects on the prevalence of female executives, we employ the industry-average-adjusted percentage of female executives as the dependent variable and find that the coefficient on

[11] Among these firms, 46 relocated their headquarters to Beijing, Shanghai, and Guangdong. This seems to suggest that the motivation for firms' relocation decision is to get closer to the financial or political center. Nevertheless, we find no evidence that firms hire more (fewer) female top managers after relocating to provinces with less (more) discrimination, possibly because the size of this relocating sample is too small and/or it takes time for a firm to change its top management team.

Sex ratio at birth is −11.042 and is significant at the 1 % level.

So far, we have controlled for the sex ratio with college degree and sex ratio in the labor force in the regression to account for the sex ratio in the general labor market pool. This method may be problematic if the influence of sex ratio with college degree and sex ratio in the labor force on the percentage of female executives is in a non-linear form. To address this concern, in Column (2) of Panel C, the dependent variable is the education-adjusted percentage of female executives, defined as (the percentage of female executives − the number of women as a percentage of the total number of people with a college degree in that province). Similarly, in Column (3), the dependent variable is the labor-adjusted percentage of female executives, defined as (the percentage of female executives − the number of women as a percentage of the total number of people in the labor force in that province). The coefficients on *Sex ratio at birth* are still negative and significant at the 1 % level.

In summary, Table 4 documents a significant and robust negative association between the percentage of female executives and the local ratio of infant boys to infant girls, indicating that firms in locations with stronger discrimination against women have fewer female top managers.

New Appointments and the Dismissal of Female Executives

A natural question arising from Table 4 is this: Is the negative association between the percentage of female top managers and the sex ratio at birth due to a lower likelihood for women to be appointed as executives or a higher likelihood for female executives to be dismissed? We further examine this issue in Tables 5 and 6. Table 5 presents the logit regression results based on all new executive appointment cases in our sample firms (1618 unique cases of appointing female executives and 11,667 unique cases of appointing male executives). The dependent variable takes the value of 1 if the newly appointed executive is a female, and 0 if the newly appointed executive is a male. We also control for the executive positions (the job title fixed effects) in the regression to account for the heterogeneity in job responsibility across top management positions. The coefficients on *Sex ratio at birth* are negative and significant at the 1 % level across all the specifications, indicating that the appointment of a female executive (relative to a male executive) is less likely to occur in a province with stronger gender discrimination.

Table 6 presents the logit regression results on executive dismissal. We start with all executive dismissal cases in our sample. To the extent that some executive departures may be due to voluntary retirement rather than forced dismissal and the typical retirement age for men (women) is 60 (55) in China, we exclude all the departing male (female) executives aged 60 (55) or above. Further, to account for the possibility that some executive departures are due to better outside job offers, we also exclude the cases in which the departing executives take executive positions in other firms within 3 years afterwards. Our final sample in Table 6 consists of 1,088 dismissal cases of female executives and 4033 dismissal cases of male executives. The dependent variable takes the value 1 if the dismissed executive is a female, and 0 if the dismissed executive is a male. We also include the manager's tenure in the regression to control for his/her seniority in the firm.

In Column (1), we focus on the firms with at least one female executive. The coefficient on *Sex ratio at birth* is not significantly different from zero. This insignificant result is likely due to the fact that the number of female executives is particularly small in the provinces with strong gender discrimination, leading to few cases of female executive departure. In Columns (2) and (3), we analyze the firms with at least two and three female executives, respectively, and the coefficients on *Sex ratio at birth* are both positive and significant. These results indicate that conditional on executive dismissal, a female executive faces a higher likelihood of being fired than her male counterparts in provinces with stronger discrimination against women. These findings are striking because one would expect that after overcoming discrimination and reaching top management positions, these female executives are particularly capable and thus less likely to be dismissed. It is possible that the result in Column (3) is simply due to the fact that there are more female executives than male executives in the subsample of firms with at least three female executives. To examine this possibility, we further require that the percentage of female executives is no larger than 50 % in Column (4) and we still find a positive and significant coefficient on *Sex ratio at birth.*

Taken together, Tables 5 and 6 show that firms in high discrimination areas are not only less likely to add a new female executive but also more likely to dismiss an existing female executive, leading to a lower percentage of female executives in the cross-section documented in Table 4.

Difference in Compensation Between Female and Male Executives

The discrimination of female executives may also lead to a pay gap in compensation between female executives and their male peers (Hoffman 1976; Barbezat 1987; Bertrand and Hallock 2001). When female executives face

Table 5 Gender discrimination and new appointments of female executives

	(1)	(2)	(3)	(4)
Sex ratio at birth	−0.161*** (0.000)	−0.173*** (0.000)	−0.178*** (0.000)	−0.187*** (0.000)
Ln (total assets)		−0.017*** (0.000)	−0.013*** (0.000)	−0.013*** (0.000)
Firm age			0.002** (0.024)	0.002** (0.029)
M/B			0.002 (0.719)	0.001 (0.751)
ROA			−0.008 (0.767)	−0.009 (0.755)
Stock volatility			0.045* (0.073)	0.045* (0.075)
Ln (Manager age)			−0.098*** (0.000)	−0.097*** (0.000)
Ln (GDP per capita)				0.004 (0.499)
Sex ratio with college degree				−0.011 (0.464)
Sex ratio in labor force				−0.043 (0.120)
Constant	−0.081 (0.148)	0.249*** (0.001)	0.531*** (0.000)	0.583*** (0.000)
Job Title FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Pseudo R^2	2.5 %	3 %	3.1 %	3.2 %
No. of observations	13,285	13,285	13,285	13,285

This table presents the logit regression results on the new appointment of female executives relative to male executives. The sample consists of 1618 new appointments of female executives and 11,667 new appointments of male executives from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The dependent variable is an indicator variable that takes the value of 1 if the newly appointed executive is a female and 0 if the newly appointed executive is a male. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2

The symbols ***, **, and * denote significance at the 1, 5, and 10 % levels, respectively. *P* values based on robust standard error clustered at the firm level are reported in parentheses

discrimination in the labor market, their compensation can be lower than that of their male counterparts because of limited job opportunities caused by discrimination.[12] In Table 7, we examine how sex ratio at birth is related to executive compensation.[13] For each female manager, we define *Pay gap* as the difference between her Ln (total compensation) and the average Ln (total compensation) of male managers who are in the same province and same industry and hold the same position. The sample mean (median) value of *Pay gap* is −0.19 (−0.15), which is significantly different from zero and indicates that female executives are paid, on average, 17 % (= $1 - e^{-0.19}$) less than their male counterparts.

We then regress *Pay gap* on *Sex ratio at birth* as well as various firm and province characteristics. We find that the coefficients on *Sex ratio at birth* are negative and significant across all specifications, indicating that the deficiency in compensation of female executives relative to their male counterparts is more severe when there is a stronger discrimination against women. Taking Column (4) for example, the coefficient on *Sex ratio at birth* is −0.653 and is significant at the 5 % level: a one-standard-deviation increase in sex ratio at birth (0.07) is associated with a more severe pay gap by 0.046 (= 0.653 × 0.07), or equivalently 4.5 % (= $1 - e^{-0.046}$) lower compensation of the female executives relative to their male counterparts. Finally, we also find that female executives in large and well-performing firms and female executives with long tenure have a narrower pay gap relative to their male counterparts.

Overall, Table 7 provides evidence that sex discrimination plays an important role in the gender pay gap between female and male top managers.

Address Reverse Causality

There is a concern of reverse causality: parents are more willing to deliver a baby girl after observing more successful women (i.e., the females who reach top executive positions in public firms), leading to a negative association between the sex ratio at birth and the prevalence of female executives in public firms. We conduct two tests to address this possibility. First, we use sex ratio at birth in 1990 (the earliest year with available province-level sex ratio information) as the key independent variable and re-estimate

[12] A counterargument can be that conditional on reaching top management positions, female managers are more capable and thus paid more.

[13] Chinese public firms started to report executive compensation information from 2005. Thus, the sample period in Table 7 is from 2005 to 2011.

Table 6 Gender discrimination and dismissal of female executives

	(1) Firms with at least one female executive	(2) Firms with at least two female executives	(3) Firms with at least three female executives	(4) Firms with at least three female executives and percentage of female executives ≤ 50 %
Sex ratio at birth	−0.081 (0.376)	0.347* (0.076)	1.046*** (0.008)	1.106** (0.043)
Ln (total assets)	−0.014*** (0.001)	−0.035*** (0.000)	−0.109*** (0.000)	−0.088*** (0.000)
Firm age	−0.001 (0.887)	0.025 (0.200)	0.054 (0.284)	0.025 (0.653)
M/B	0.001 (0.454)	−0.004 (0.316)	−0.014*** (0.001)	−0.019*** (0.002)
ROA	−0.018 (0.666)	0.008 (0.938)	0.231 (0.182)	0.113 (0.563)
Stock volatility	0.104* (0.076)	0.551* (0.070)	1.168** (0.047)	1.722*** (0.009)
Ln (Tenure)	0.028*** (0.001)	0.072*** (0.000)	0.079** (0.042)	0.069 (0.103)
Ln (Manager age)	−0.192*** (0.000)	−0.373*** (0.000)	−0.364** (0.021)	−0.209 (0.141)
Ln (GDP per capita)	0.015 (0.150)	0.013 (0.569)	0.042 (0.324)	0.048 (0.386)
Sex ratio with college degree	−0.007 (0.793)	−0.036 (0.531)	0.205 (0.117)	0.229* (0.071)
Sex ratio in labor force	0.012 (0.814)	0.066 (0.554)	0.427** (0.041)	0.423* (0.062)
Constant	0.554*** (0.006)	0.980** (0.022)	0.445 (0.646)	−0.787 (0.509)
Job Title FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Pseudo R^2	9.3 %	8.8 %	15.0 %	13.9 %
No. of observations	5,118	1,797	534	432

This table presents the logit regression results on the dismissal of female executives relative to male executives. The sample consists of 1,088 female executive departure cases and 4,033 male executive departure cases from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The dependent variable is an indicator variable that takes the value of 1 if the departing executive is a female, and 0 if the departing executive is a male. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2

The symbols ***, **, and * denote significance at the 1, 5, and 10 % levels, respectively. *P* values based on robust standard error clustered at the firm level are reported in parentheses

Eq. 1.[14] As reported in Table 8 Panel A, the coefficients on *Sex ratio at birth 1990* are all negative and significant at the 1 % level, implying that firms are less likely to have female executives when there is a strong discrimination against females. This test helps mitigate the above reverse causality concern because it is impossible for parents in 1990 to base their reproduction decisions on the prevalence of female top managers in the 2000–2011 period.

As our second test to investigate the possibility of reverse causality, we examine whether the relation between sex ratio at birth and the prevalence of female executives is stronger in large firms or in small firms. Considering that large firms are usually more influential than small firms, one should expect the relation between sex ratio at birth and the prevalence of female executives to be stronger in large firms if the prevalence of female executives drives local gender bias. In contrast, small firms generally are more reliant on local market and thus are more easily influenced by local gender bias. For this reason, one should expect the relation between sex ratio at birth and the prevalence of female executives to be stronger in small firms if local gender bias drives the prevalence of female executives. In Panel B of Table 8, we define the *Big firm indicator* variable that takes the value of 1 if the firm's total assets are in the top quartile of the sample, and 0 otherwise. Then, we re-estimate Eq. 1 by including the *Big firm indicator* and its interaction with the sex ratio at birth variable. In Column (1) of Panel B, we find that the coefficient on the interaction term, *Sex ratio at birth 1990* × *Big firm indicator,* is positive and significant at the 5 % level, indicating that the effect of local gender bias is stronger in small firms than in large firms. In Column (2), we use the contemporaneous sex ratio at birth and continue to find a positive and significant coefficient on the interaction, *Sex ratio at birth* × *Big firm indicator*. These results are opposite to what the reverse causality explanation predicts, and indicate that gender bias drives the prevalence of female top managers and it is not the other way round.

[14] Chongqing became a municipality in 1997. Prior to that, Chongqing is part of Sichuan Province and there is no sex ratio data available for Chongqing in 1990. Therefore, we apply the 1990 sex ratio of Sichuan to Chongqing.

Table 7 Gender discrimination and pay gap between female and male executives

	(1)	(2)	(3)	(4)
Sex ratio at birth	−0.676** (0.029)	−0.571* (0.065)	−0.531* (0.081)	−0.653** (0.040)
Ln (total assets)		0.143*** (0.000)	0.133*** (0.000)	0.149*** (0.000)
Firm age			0.008* (0.059)	0.009** (0.047)
M/B			0.040** (0.026)	0.048** (0.011)
ROA			1.098*** (0.000)	1.178*** (0.000)
Stock volatility			0.085 (0.651)	0.044 (0.819)
Ln (Tenure)			0.156*** (0.000)	0.155*** (0.000)
Ln (Manager age)			0.167 (0.158)	0.204* (0.079)
Ln (GDP per capita)				−0.208*** (0.000)
Sex ratio with college degree				−0.003 (0.973)
Sex ratio in labor force				0.323* (0.059)
Constant	0.370 (0.329)	−2.531*** (0.000)	−3.414*** (0.000)	−2.432*** (0.001)
Job Title FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R^2 (%)	12.9	17.7	21.6	23.3
No. of observations	6885	6885	6885	6885

The sample consists of 6,885 female executive-year observations from 2005 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The dependent variable, *Pay gap*, is the difference between the Ln(total compensation) of each female executive and the average Ln (total compensation) of all male executives who are in the same province and same industry and hold the same position. All dollar value variables are measured in 2011 constant dollars, and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2

The symbols ***, **, and * denote significance at the 1, 5, and 10 % levels, respectively. *P* values based on robust standard error clustered at the firm level are reported in parentheses

Change in Sex Ratio at Birth and Change in Percentage of Female Executives

It is possible that some unobserved factors are driving our results. To alleviate this concern, we implement the change analysis in this section. In particular, for each province, we compute the change in the province-level percentage of female executives over our sample period as (the province-level percentage of female executives in 2011) − (the province-level percentage of female executives in 2000). The province-level percentage of female executives is the average percentage of female executives in the firms of a given province. Similarly, we compute the change in other firm and province characteristics from 2000 to 2011. Then, we regress the change in the province-level percentage of female executives on the changes in sex ratio at birth (Δ*Sex ratio at birth*) as well as other changes in the firm and province characteristics.

Table 9 reports the results. We find that the coefficients on Δ*Sex ratio at birth* are negative and significant at (at least) 10 % level across all the columns. This result indicates that provinces with a greater decrease in sex discrimination have a greater increase in the female representation in the top management teams.

Female Board of Directors

Women hold not only few corporate executive positions but also few board seats, relative to men. For example, women held only 16.6 % of Fortune 500 board seats in 2012 (Catalyst 2012).[15] Despite few women on the board, Adams and Ferreira (2009) find that having female directors usually increases board effectiveness. Thus, it is an interesting question to ask: why are few women in the boardroom while they usually enhance board effectiveness? Does sex discrimination also play a role in director selection? To investigate this question, we extend our analysis from the top management team to the board of directors in Table 10.

The regression specification follows Eq. 1. The dependent variable in Column (1) is the number of women as a percentage of the total number of executives and non-executive directors. The significant and negative coefficient on *Sex ratio at birth* indicates that firms in the provinces with a higher sex ratio at birth have fewer female corporate executives and non-executive directors, consistent with the

[15] http://www.catalyst.org/media/catalyst-2012-census-fortune-500-no-change-women-top-leadership.

Table 8 Addressing reverse causality

	(1)	(2)	(3)	(4)
Panel A: using sex ratio at birth in 1990				
Sex ratio at birth 1990	−31.226*** (0.001)	−31.519*** (0.001)	−30.856*** (0.001)	−29.792*** (0.005)
Ln (total assets)		−1.223*** (0.000)	−1.279*** (0.000)	−1.433*** (0.000)
Firm age			0.157** (0.034)	0.140* (0.058)
M/B			0.213 (0.450)	0.164 (0.560)
ROA			3.349 (0.196)	2.846 (0.267)
Stock volatility			−9.929 (0.107)	−9.568 (0.118)
Ln (GDP per capita)				1.522** (0.016)
Sex ratio with college degree				−1.412 (0.180)
Sex ratio in labor force				−2.831 (0.330)
Constant	47.176*** (0.000)	70.912*** (0.000)	71.236*** (0.000)	67.295*** (0.000)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R^2	8.5 %	9.3 %	9.4 %	9.7 %
No. of observations	13,624	13,624	13,624	13,624

	(1)	(2)
Panel B: the effect of firm size		
Sex ratio at birth 1990	−41.409*** (0.001)	
Sex ratio at birth 1990 × big firm indicator	41.291** (0.018)	
Sex ratio at birth		−14.812*** (0.001)
Sex ratio at birth × big firm indicator		17.512** (0.019)
Big firm indicator	−46.946** (0.014)	−22.499** (0.011)
Firm age	0.108 (0.144)	0.118 (0.109)
M/B	0.735*** (0.008)	0.741*** (0.007)
ROA	0.119 (0.963)	0.193 (0.940)
Stock volatility	−7.994 (0.191)	−7.567 (0.218)
Ln (GDP per capita)	1.412** (0.025)	0.892 (0.142)
Sex ratio with college degree	−1.359 (0.201)	−1.388 (0.179)
Sex ratio in labor force	−3.087 (0.291)	−0.276 (0.918)
Constant	53.436*** (0.000)	26.054*** (0.002)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted R^2	9.4 %	9.3 %
No. of observations	13,624	13,624

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The dependent variable is the percentage of female executives in the firm's top management team (measured in percentage points). Sex ratio at birth 1990 is the ratio of newborn boys over newborn girls in each province in year 1990. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2

The symbols ***, **, and * denote significance at the 1, 5, and 10 % levels, respectively. *P* values based on robust standard error clustered at the firm level are reported in parentheses

findings in Table 4. We further examine the percentage of female directors on the board in Column (2) and still find a significantly negative coefficient of −7.135 on *Sex ratio at birth*. The economic magnitude of this coefficient is also nontrivial: an increase in *Sex ratio at birth* by one standard deviation (0.07) is associated with a decrease in the percentage of female directors on the board by 0.5 % (= 0.07 × 7.135 %), considering that the sample average percentage of female directors on the board is 9.8 %. Overall, our results suggest that sex discrimination prevents women not only from reaching top management positions but also from joining the boardroom.

Table 9 Change in sex ratio and change in percentage of female executives

	(1)	(2)	(3)	(4)
Δ Sex ratio at birth	−28.089** (0.025)	−28.975** (0.023)	−27.441* (0.053)	−31.290** (0.014)
Δ Ln(total assets)		0.757 (0.762)	−0.595 (0.796)	1.453 (0.581)
Δ Firm age			−0.139 (0.793)	0.275 (0.648)
Δ M/B			−0.847*** (0.000)	−1.319*** (0.000)
Δ ROA			29.567 (0.520)	−14.775 (0.745)
Δ Stock volatility			−6.209 (0.922)	−84.939 (0.280)
Δ Ln(GDP per capital)				−3.005 (0.259)
Δ Sex ratio with college degree				−8.088** (0.039)
Δ Sex ratio in labor force				−25.281 (0.106)
Constant	3.021*** (0.001)	1.897 (0.602)	5.019 (0.244)	2.882 (0.647)
Adjusted R^2	5.4 %	2.3 %	31.7 %	38.8 %
Observations	31	31	31	31

This table examines the relation between the change in the province-level sex ratios and the change in the province-level proportion of female executives. The dependent variable is the change in the province-level percentage of female executives from 2000 to 2011 (measured in percentage points), which is defined as (the province-level average percentage of female executives in 2011) − (the province-level average percentage of female executives in 2000). Similarly, all the independent variables are the changes at the province level from 2000 to 2011. For example, ΔLn(total assets) is defined as (the province-level average Ln(total assets) in 2011) − [the province-level average Ln(total assets) in 2000]. The symbols ***, **, and * denote significance at the 1, 5, and 10 % levels, respectively. *P* values based on robust standard error clustered at the province level are reported in parentheses

Table 10 Gender discrimination and percentage of female directors

	(1) Female as percentage of total # of executives and non-executive directors	(2) Female as percentage of total # of directors
Sex ratio at birth	−8.024*** (0.002)	−7.135** (0.013)
Ln (total asset)	−1.383*** (0.000)	−1.409*** (0.000)
Firm Age	0.093** (0.049)	0.054 (0.282)
M/B	−0.215 (0.268)	−0.464** (0.031)
ROA	−0.066 (0.968)	−1.338 (0.438)
Stock volatility	−7.235* (0.058)	−9.045** (0.027)
Ln (GDP per capita)	0.903** (0.018)	0.682 (0.101)
Sex ratio with college degree	−0.601 (0.396)	−0.687 (0.369)
Sex ratio in labor force	−1.023 (0.543)	−1.193 (0.512)
Constant	43.448*** (0.000)	44.204*** (0.000)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted R^2	11 %	6.6 %
No. of observations	13,624	13,624

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. In Column (1), the dependent variable is the number of women as percentage of the total number of executives and non-executive directors (measured in percentage points). In Column (2), the dependent variable is the number of women as percentage of total number of directors (measured in percentage points). All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The symbols ***, **, and * denote significance at the 1, 5, and 10 % levels, respectively. *P* values based on robust standard error clustered at the firm level are reported in parentheses

Conclusions

Why are female executives underrepresented in large firms? Does sex discrimination play a role? Although it is widely suspected that women are discriminated from reaching the top management position, evidence is lacking. This absence of evidence is probably due to the difficulties of measuring sex discrimination, and makes it difficult for us to fully understand how the executive labor market is shaped by social norms.

In this paper, we use the sex ratio at birth as a measure of discrimination against women and find that firms headquartered in more discriminatory areas have a lower proportion of female executives in their top management team. This relation arises from the fact that those firms are less likely to add new female executives but are more likely to remove existing female ones. Even if females reach top management positions, they are paid significantly less than their male counterparts in areas exhibiting stronger discrimination. Overall, we provide evidence that discrimination is an important factor that prevents women from climbing the corporate ladder.

Our study suggests a few directions for future research. First, as we discussed in the Introduction section, the effect of sex discrimination on female executives can be through both the supply channel (i.e., sex discrimination reduces the supply of qualified female candidates for executive positions) and the demand channel (i.e., sex discrimination reduces the demand of public firms for female executives). The relative importance of the two channels is worth further investigation in the future. Second, although our paper focuses on China, the basic mechanism could be applied to other countries with an imbalanced sex ratio at birth, including Singapore, India, South Korea, Taiwan, Vietnam, Hong Kong, etc. Studies of international data on this issue could be an interesting area for future research. Lastly, while the sex ratio at birth in the U.S. is fairly balanced on average, there is still noticeable variation across different races and birth orders within the country. As reported by Egan et al. (2011), in the U.S. from 1975 to 2002, the sex ratio at birth is 1.053 for Whites, 1.030 for Blacks, 1.074 for Chinese, 1.073 for Filipinos, 1.068 for Asian Indians, and 1.080 for Koreans. The highest sex ratios are seen for third + births to Asian Indians (1.126), Chinese (1.111), and Koreans (1.109). Considering Asian Americans are a growing and sizeable part of the total population of the U.S., their gender preference could have important implications on the U.S. economy, which deserves more investigation in future research.

Appendix 1: Global Sex Ratio at Birth in 2011 (A Partial List)

This table reports a partial list of global sex ratio at birth in 2011, reported in World Factbook published by the Central Intelligence Agency (https://www.cia.gov/library/publications/download/download-2011/).

Country	Sex ratio at birth (male/female)	Global rank of sex ratio at birth
China	1.13	1
Armenia	1.12	2
India	1.12	3
Albania	1.12	4
Vietnam	1.12	5
Azerbaijan	1.12	6
Georgia	1.11	7
Grenada	1.10	8
San Marino	1.09	9
Kosovo	1.08	10
Taiwan	1.08	11
Isle of Man	1.08	12
Republic of Macedonia	1.08	13
Singapore	1.08	14
Hong Kong	1.07	15
Bosnia and Herzegovina	1.07	16
Montenegro	1.07	17
Faroe Islands	1.07	18
Gibraltar	1.07	19
Tunisia	1.07	20
South Korea	1.07	21
Malaysia	1.07	22
Suriname	1.07	23
Portugal	1.07	24
Luxembourg	1.07	25
Spain	1.06	28
Sweden	1.06	36
Russia	1.06	39
Italy	1.06	54
Canada	1.06	63
Japan	1.06	63
Australia	1.05	66
Denmark	1.05	66
Germany	1.05	66
Norway	1.05	71
Switzerland	1.05	71
Netherlands	1.05	76
United Kingdom	1.05	76
United States	1.05	147

Appendix 2: Variable definitions

Variable	Definition
Big firm indicator	An indicator variable that takes the value of 1 if the firm's total assets are in the top quartile of the sample, and 0 otherwise

Variable	Definition
Capex	Capital expenditures normalized by total assets
Firm age	Number of years since the firm went public
GDP per capita	Total GDP divided by the resident population in a province
Leverage	Book value of debts normalized by total assets
Manager age	Age of the manager
M/B	Market value of equity to book value of equity
Pay gap	Difference between a female manager's Ln (total compensation) and the average Ln (total compensation) of male managers who are in the same province and same industry and hold the same position
Percentage of female directors	Number of female directors normalized by the total number of directors
Percentage of female executives	Number of female executives normalized by the total number of executives
Percentage of female executives and directors	Number of female executives and directors normalized by the total number of executives and directors
ROA	Net income normalized by average total assets at the beginning and the end of the year
Sex ratio at birth	Ratio of number of newborn boys over the number of newborn girls in a province
Sex ratio in labor force	Ratio of the number of men in the labor force over the number of women in the labor force in a province
Sex ratio with college degree	Ratio of number of men with college degree over the number of women with college degree in a province
Stock volatility	Standard deviation of monthly stock return for the prior 60 months
Tenure	Number of years the executive is in the position
Total assets	Book value of total assets (US$ millions)

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