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# CEO gender and firm performance: It is the predecessor-successor gender combination that matters!

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## ABSTRACT

This study was set to provide a response to the following question: What is the relationship between the gender of CEO successor and firm performance? We analyzed data from 4,338 CEO successions in companies listed in China Stock Exchanges from 2001 to 2016. We utilized Propensity Score Estimation for multiple treatments to operationalize different gender combinations in CEO succession (male-to-male, male-to-female, female-to-male, female-to-female). Findings suggested that it is CEO succession with different gender instead of a female successor that hurts firm performance. We also found that the power of female successors serves as a moderator: it can mitigate the negative impact of different-gender CEO succession on firm performance. The results also indicated that firm ownership (state-owned vs. non-state owned) influences the relationship between female-male CEO succession and firm performance. Practical implications: The findings imply that the gender of the CEO per se may not be the prime factor in firm performance, instead what firms should pay attention at is to smoothen the succession processes when a CEO of different gender is appointed.

**Contribution/Originality:** The study expands research on corporate governance by looking at how the combination of predecessor-successor gender in CEO succession relates to corporate performance. Furthermore, the study extends the utilization of the Propensity Score Method to multiple treatments.

## 1. INTRODUCTION

A substantial amount of literature has focused on the relationship of executives' gender and firm performance. The CEO is the top executive who is responsible for the affairs and success of an enterprise, and hence, has arguably the most important role in the top management team (Fanelli & Grasselli, 2006; Fitza, 2014; Legrand, Al Ariss, & Bozionelos, 2019). Consequently, it is of interest to investigate how the personal characteristics of CEOs, such as gender, relate to firm performance. Furthermore, albeit much still needs to be done, more and more women are breaking the "glass ceiling" to reach the top of corporate hierarchies (Rao, 2019; Ting, 2021). It is meaningful to know, therefore, how firms perform when they are led by women compared to when they are led by men.

Empirical research on how CEO gender (i.e., female or male) relates to firm performance is equivocal, with available evidence not allowing a clear conclusion (Laidoja, Li, Liu, & Ren, 2022). Indeed, most studies find no systematic relationship between the gender of the CEO and firm performance (for recent examples, (Al-Begali & Phua, 2023; Brush & Elam, 2023; Espinosa-Méndez & Correa, 2022; Kubo & Nguyen, 2021)), and those that find are inconsistent in their results, some identifying male (Wang, Holmes Jr, Devine, & Bishoff, 2018) and some female CEOs (e.g., (Hoang, Nguyen, & Van Tran, 2019)) connected with firm financial performance.

In view of the equivocal evidence, authors consider that both the choice of research objects (i.e., what to observe) and the treatment of endogeneity should be taken into consideration (Kirsch, 2018; Liu, 2021).

Regarding the market response to female CEO succession, this is generally biased against female CEOs (Braegelmann & Ujah, 2020). For example, Lee and James (2007) found that investors responded differently to female CEO succession and male CEO succession, and that female CEO succession had a negative impact on stock prices. And Liu, Park, and Velamuri (2023) found that initial public offerings (IPOs) led by female CEOs were more likely to incur underpricing. Based on the assumption that the stock price reflects the company's accounting performance (Li & Liu, 2012), investors generally expect that succession of female CEOs will hurt firm performance, which is often considered as one of the explanations for the ratio imbalance of female CEOs (Kirsch, 2018).

Based on the above background, in the present work we focused on the relationship between the gender of CEO successor and firm performance. More precisely, we investigated whether CEO succession with female successor or with successor of different gender hurts firm performance. Therefore, what we pose in this work is the following: it is ***not*** the CEO gender per se (i.e., male vs. female) that matters for firm performance, but rather whether the successor CEO is of different gender from the predecessor.

## 2. THEORETICAL BACKGROUND

CEO succession can be a "disruptive" process (Boyne, James, John, & Petrovsky, 2011; Georgakakis & Buyl, 2020; Grusky, 1964). Anything that intensifies this disruption harms firm performance, and slowing down this disruption can improve the company's performance. Here we pose that the replacement of CEO with different gender functions as disruption in the internal environment of the firm, which may damage its performance, and factors that can slow down the disruption may play a moderating role. If both the predecessor and the successor CEO are women, their preferences and styles are similar, and the team's recognition of female leaders is strengthened, thus the succession of female CEOs may not harm the performance of the firm.

To deal with the methodological challenges posed by the endogenous nature of CEO succession (Kirsch, 2018; Li & Ding, 2016), in the present study we utilized Propensity Score Estimation (Rosenbaum & Rubin, 1983). In particular, we utilized the *Propensity Score Estimation for Multiple Treatments* (McCaffrey et al., 2013), which we applied to the four categories of gender combinations in CEO succession: male-to-male, male-to-female, female-to-male, female-to-female. This method uses the machine learning GBM (Generalized Boosted Model) algorithm. It performs iterative fitting with a large number of regression trees to capture the complex nonlinear relationship between the treatment group and the covariates, which can better achieve the balance of covariates between the treatment group and the control group (Parast et al., 2017). Via estimating the pairwise average treatment effects (ATEs), we could clarify the relationship among the four classifications.

If CEO succession with different gender (either male-to-female or female-to-male) hurts firm performance, then male-to-female and female-to-male succession will be negatively related to firm performance, while female-to-female succession will not have a negative impact. On the other hand, if it is specifically CEO succession with a female successor that hurts firm performance, then both male-to-female and female-to-female succession will be negatively related with post-succession firm performance, while female-to-male succession will not have a negative effect.

Our analysis of data from 4,338 CEO successions in Chinese listed companies from 2001 to 2016 showed that: (1) It is the replacement of the CEO with different gender that hurts firm performance, not the replacement specifically with a female CEO. (2) The power of the successor can weaken the negative impact of the male-to-female CEO succession. (3) The state-owned nature of the company can weaken the negative impact of female-to-male CEO succession on performance.

The contributions of this work are: (1) We expand research on corporate governance. Such research thus far has primarily focused on the gender of executives themselves, so looking not at the gender of the CEO but instead at whether succession is with a CEO of different gender is a novel perspective. And we supplement the explanation to

the ratio imbalance of female CEOs. (2) We identify two important moderators that add to our capacity to recognize factors that increase (or decrease) the harm on firm accounting performance caused by succession with CEO of different gender. (3) We extend the utilization of the propensity score method. This method is typically utilized with data that fall into two categories or cells. We introduce the propensity score method for multiple treatments, which is applied to the four categories or cells of CEO succession (female-to-female, male-to-male, male-to-female, female-to-male).

## 3. HYPOTHESIS DEVELOPMENT

CEO successions are crucial events in firms life cycle because of the symbolic and substantive role of the CEO position (Finkelstein & Hambrick, 1996). Therefore, for reasons we pointed at earlier, we believe that CEO succession with different gender may considerably change the existing model of management team, leading to disruptions in the internal environment that can damage firm performance. On the other hand, CEO succession with same gender, such as female-to-female, can help to reduce the damage of disruption because of the relatively similar corporate leadership style and preference of a same-gender successor.

According to the Social Identity Theory (Koenig & Eagly, 2014; Tajfel & Turner, 1986), individuals classify people according to their salient characteristics, so as to identify with the group they belong to, and generate internal group preferences and external group bias. Chattopadhyay, Tluchowska, and George (2004) pointed out that gender (along with race) is the most important criterion for social categorization because they are intuitive and stable. Many studies show that there are differences in social identity between female and male CEOs (e.g., (Allemand, Bédard, Brullebaut, & Deschênes, 2022; Dixon-Fowler, Ellstrand, & Johnson, 2013)). Zhu, Shen, and Hillman (2014) found new CEOs go through the process of reclassification as in- and out-group with respect to their colleagues. The performance of female CEO will affect investors' evaluation of female CEOs in other companies, because female CEOs are rarer.

Therefore, we argue that the re-classification faced by the new CEO depends on the characteristics of the former CEO who can be regarded as part of the in-group (Zhu et al., 2014). If the former CEO is male, the female successor is likely to be labeled as out-group, which reduces the efficiency of the senior management team. However, if the former CEO is female, the team's social identity and acceptance of female leaders will be enhanced, and the female successor will no longer be excluded by the original group.

On the basis of the above discussion, we pose the following hypothesis.

*Hypothesis 1: CEO succession with different gender (male-to-female, female-to-male) is negatively related with subsequent firm performance, while there is no systematic relationship between female-to-female CEO succession and firm performance.*

### 3.1. The Moderating Effects of CEO Power and Firm Ownership

According to role congruity theory (Eagly & Karau, 2002), the female gender is perceived inconsistent with the role of leader (e.g., (Tresh et al., 2019)). For example, Wang, Markóczy, Sun, and Peng (2019) found that people have different opinions on whether female and male CEOs are competent based solely on the characteristics that are stereotypical for their gender. Therefore, male-to-female and female-to-male CEO succession may be considered different, which should be reflected in different moderating effects of the two kinds of succession.

#### 3.1.1. CEO Power

Child (1972) proposed that power is a key factor for managers to implement strategies. And Finkelstein (1992) established the CEO power model by suggesting that the CEO has two core tasks and four bases of power. The first task is to deal with the internal uncertainty that is to deal with the board of directors and other key stakeholders; the second task is to deal with external uncertainty, that is the fluctuation of the external environment. For the first task,

the CEO has organizational power and ownership power, so that he/she can control the internal environment. For the second task, the CEO has prestige power and expert power, so that he/she can be supported and trusted.

Adams, Almeida, and Ferreira (2005) pointed out that only when executives have enough power on corporate decision-making can they influence corporate performance. Han and Li (2009) found that when companies experienced financial crisis, the lower the CEO power, the more serious the crisis is; the greater the CEO power, the better the financial performance will become.

Oliver, Krause, Busenbark, and Kalm (2018) and found that firms with female CEOs used more the board functions of service and collaboration, while firms with male CEOs preferred the board functions of control and supervision. Oliver et al. (2018) labeled it "benevolent sexism", the board believes that female CEOs need more help and cooperation from the team, which gives them more power, while male CEOs need more supervision than power.

Based on the above discussion, we argue that CEO power is more useful for female successors than for male successors, hence, we pose the following hypothesis.

*Hypothesis 2: The power of successor CEO can weaken the negative impact of male-to-female CEO succession on firm performance, but does not have any systematic effect on the relationship between female-to-male CEO succession and firm performance.*

#### *3.1.2. The State-Owned Nature of the Enterprise*

In China, compared with private enterprises, state-owned enterprises are less sensitive to firm performance. For example, Zhang and Qu (2016) found that the probability of CEO's early dismissal in state-owned enterprises was lower than that in private enterprises. Gao (2015) pointed out that the appointment of CEOs in state-owned enterprises in China is not always through market competition, but through the "unique insight" of state-owned assets regulatory agencies. Although the state has been committed to the de-administrative reform of state-owned enterprises, the administrative level system of state-owned enterprises is still deeply rooted (Chen, Lu, Jiang, & Wang, 2015). Because of the above background, the senior management team of state-owned enterprises enjoys greater stability, and the CEOs of state-owned enterprises are usually at a higher level than others within the same political system, which is easy to be recognized by internal groups.

There is a difference in the proportions of female CEOs between state-owned and private firms in China. Zhang (2012) found that the proportion of female CEOs in private enterprises was increasing, reaching 8.2% in 2010, while the proportion of female CEOs in state-owned enterprises was rather stable over the years, only 3.6% in 2010; and this trend has not changed since (Javaid, Ain, & Renzi, 2023). There are two main reasons for this significant gap: First, it is not unusual that female CEOs in private enterprises are the founders of the company, or close relatives of the founders (Khidmat, Habib, Awan, & Raza, 2022). Family businesses provide a shortcut for females to become CEOs. Second, private enterprises are facing greater competition and have the motivation to look for talents with different backgrounds; while the state-owned enterprises are located in the "comfort zone" and can continue promoting the existing male status quo (Han, Cui, Chen, & Fu, 2019; Javaid et al., 2023; Zhang, 2012).

Considering the above, we believe that in state-owned enterprises, the male-to-female CEO succession may be perceived as an event deviating from "normality", while the female-to-male CEO succession may be considered as an event returning to the normality. Thus, the following hypothesis was posed.

*Hypothesis 3: The state-owned nature of the firm weakens the negative impact of female-to-male CEO succession on firm performance, but does not have an influence on the relationship between male-to-female CEO succession and firm performance.*

## 4. METHOD

### *4.1. Data and Procedure*

Except for some data that needed to collect manually, all data were directly obtained from the CSMAR (China Stock Market & Accounting Research) database, the leading database of this type. The CSMAR database is designed

and developed in accordance with international standards of practice, including company financial data, executive data and related economic information of listed companies in China.

We selected all A-listed companies in China's Shanghai and Shenzhen Stock Exchanges from 2001 to 2016 (inclusive) as the initial sample. The number of listed companies in China's Shanghai and Shenzhen Stock Exchanges rose from 1,160 in 2001 to 3,337 in 2016. The proportion of female CEOs in the listed firms was 4.5% in 2001, and 6.1% in 2016. China fares relatively well in this domain, the proportion of female CEOs in Chinese companies being above the average in developed countries (Cain-Miller, 2018; Matanda, Wang, & Emelianova, 2023).

In the next step, we conducted data screening and processing as follows: (1) We excluded financial industry companies like banking and security enterprises, as their financial statements have different structures and indicators from other companies; (2) We excluded ST (special treatment) companies, which face risk of delisting; (3) We excluded data missing samples; (4) We conducted an up and down 1% Winsorization of continuous variables.

In the end, 4,338 points of CEO succession were obtained, concerning 1,650 different listed companies in China.

### *4.2. Measures*

#### *4.2.1. Firm Performance*

We utilized the IMROA (Industry Median ROA) as measure of company performance. The IMROA is based on Return on Assets (ROA). The calculation method (Cheng, 2016) is as follows:

ROA = Net Income / (Total Asset closing balance + Total Asset opening balance) / 2

As industries are affected in various ways by the macro environment, we implemented the Median adjustment for ROA by industry. According to the *Listed Companies Classification and Code* issued by the China Securities Regulatory Commission, companies are categorized into 13 industries. Thus, we utilized 12 categories after removing the financial industry. ADROA represents the industry-adjusted ROA, and MEDIA represents the median industry performance for the year. The formula is expressed as follows:

ADROA = ROA - MEDIA

Our study examined the impact of CEO succession on firm performance. Therefore, IMROA measures the firms' short-term performance before and after CEO succession. It is industry-adjusted performance one year after CEO succession minus the industry-adjusted performance in the previous year. Intuitively, a positive IMROA represents a performance improvement after succession; and a negative IMROA signifies that the performance did not improve. Specifically, the formula is expressed as follows:

$IMROA = ADROA_{t+1} - ADROA_{t-1}$

#### *4.2.2. Independent Variables*

We set three dummy variables MF, FM, FF as explanatory variables. If it is a male-to-female succession, then MF is coded as "1", FM and FF are coded as "0". If it is a female-to-male succession, then FM is coded as "1", MF and FF are coded as "0". If it is a female-to-female succession, then FF is coded as "1", MF and FM are coded as "0". If it is a male-to-male succession, then MF, FM and FF are all coded as "0".

#### *4.2.3. Moderators*

We utilized the successor duality indicator SUC_DUAL to express CEO's power, because in Chinese business management practice, the leadership structure is the most important factor to affect CEO's power in listed companies. The CEO is appointed by the board of directors and is directly responsible to the board of directors, so the dual position greatly enhances the CEO's power (Xiong, Cheng, & Pan, 2016). If the successor is both chairman and CEO, SUC_DUAL is coded as "1", otherwise "0".

The dummy variable SOE was set as the "state-owned enterprise" indicator. State ownership is an important characteristic in the Chinese market. Research finds that CEOs of state-owned enterprises (SOEs) have less power

than CEOs in non-SOEs (Lin, Lu, Zhang, & Zheng, 2020). If the company is a state-owned enterprise, SOE is coded as "1", and "0" for private enterprise.

### *4.3. Controls*

We controlled for the following firm-level variables: PRE_ADROA is the firm's industry-adjusted performance one year before the CEO succession; FIRM_SIZE is the company's size, obtained from the natural logarithm of the total assets in the year of succession; FIRM_AGE is the company's age, obtained from the natural logarithm of the number of years between the company's establishment and the CEO succession; and DA_RAT is the debt-to-asset ratio in the year of succession, which measures the company's total capital structure.

Moreover, we controlled for the following demographic and corporate governance variables at executive level: IND_DIRE, the proportion of independent directors in the firm's board in the year of the succession; FE_BOARD_RAT, the proportion of female directors in the firm's board in the year of the succession; SUC_OWN, the ratio of the successor's shareholding to the total share capital; and SUC_AGE, the successor's age.

Finally, we controlled for the year the succession took place and the industry, YEAR and INDUSTRY (dummy variables) to take into account possible over-time market changes and industry impact. All variables are listed in Table 1.

**Table 1.** Description of all variables in the study.

| Variables | Variable name | Variable definition |
|---|---|---|
| Dependent variable | IMROA | Firm performance improvement: $IMROA=ADROA_{t+1}-ADROA_{t-1}$. |
| Independent variables | MF | If it is a male-to-female succession, MF=1; otherwise MF=0. |
| | FM | If it is a female-to-male succession, FM=1; otherwise FM=0. |
| | FF | If it is a female-to-female succession, FF=1; otherwise FF=0. |
| Moderators | SUC_DUAL | If the successor is both chairman and CEO, SUC_DUAL=1; otherwise SUC_DUAL=0. |
| | SOE | If the company is a state-owned enterprise, SOE=1; otherwise SOE=0. |
| Control variables | PRE_ADROA | Company's industry-adjusted performance one year before the CEO succession. |
| | FIRM_SIZE | Company's size, obtained from the natural logarithm of the total assets. |
| | FIRM_AGE | Company's age, obtained from the natural logarithm of the number of years between the company's establishment and the CEO succession. |
| | DA_RAT | Debt to asset ratio = Total debt / Total assets. |
| | IND_DIRE | Proportion of independent directors in the board of directors. |
| | FE_BOARD_RAT | Proportion of female directors in the board of directors. |
| | SUC_OWN | Ratio of the successor's shareholding to the total share capital. |
| | SUC_AGE | Successor's age. |
| | Year | Year dummy variables, which involve 16 years, thus 15 variables were set. |
| | Industry | Industry dummy variables, which involve 12 industries, thus 11 variables were set. |

### *4.4. Data Analytic Technique and Model Design*

As we already discussed, the CEO succession event is affected by endogeneity. There is also some evidence that certain industries, such as cultural and entertainment-related industries, have higher acceptance of female executives, and female executives may prefer some socially responsible companies (Kirsch, 2018). Therefore, with respect to appointments of female CEOs, endogeneity is very likely to be present.

To reduce the impact of endogeneity, we utilized Propensity Score Estimation. It is a "counterfactual inference model" that is utilized with non-experimental data with the following inference rules: If A does not exist, then we get the result of B. But if at this time A has already occurred, thus for the group under the intervention state, the counterfactual is the potential result in the processing state.

The basic idea is as follows: First, establish the probability model p(z)=p(D=1 | Z) of the individual entering the processing group, where D is the dummy variable: D=1 represents the individual in the processing group; D=0 represents the individual in the control group. Z is a set of observable characteristic variables that affect the individual's choice. The estimated probability p(z) of the individual entering the treatment group is the propensity score. Second, each individual in the treatment group (D=1) is matched to an individual in the control group (D=0) with a similar propensity score. The results of samples in the control group can be regarded as the possible outcomes when treated samples did not enter the treatment group. On this basis, we obtain the following definition: Y[1] indicates the potential outcome of the individual entering the treatment group; Y[0] indicates the potential outcome of the individual entering the control group; Y[1] - Y[0] is the treatment effect of the individual; and we focus on the average treatment effect ATE=E(Y[1] - Y[0]).

The Propensity Score method is usually applied to two categories of data, such as male or female, in which the female is the treatment group and the male is the control group. In order to deal with the four gender combinations of CEO succession, we introduced the Propensity Score Estimation for Multiple Treatments designed by McCaffrey et al. (2013). The basic procedures are as follows:

*Estimation of propensity scores using the GBM algorithm.* We applied the generalized boosted model (GBM) algorithm (Friedman, 2001; McCaffrey, Ridgeway, & Morral, 2004) to estimate the propensity scores, that is the probability an individual Z enters each category p(z)=p(D=t | Z), where D=t (t=1, 2, 3, 4) indicates the individual entering four categories: male-to-male, male-to-female, female-to-male, female-to-female; Z is a set of observable characteristic variables that affect individual choice; $\sum_{t=1}^{4} p(z)=1$.

The GBM algorithm is a derivative application of machine learning (Lee, Lessler, & Stuart, 2010). It is an iterative fitting algorithm consisting of a large number of regression trees that captures the complex nonlinear relationship between treatment groups and covariates. It can optimize the trade-off process of deviations and achieve better coordination. The balance of the variables in the treatment and control groups yields more accurate estimates and smaller mean square errors (Parast et al., 2017). In our study, propensity scores were estimated using FIRM_SIZE, FIRM_AGE, DA_RAT, PRE_ADROA, SOE, IND_DIRE, FE_BOARD_RAT, YEAR, and INDUSTRY, which may affect the individual's choice.

### *4.5. Calculation of Pairwise Effects*

We calculated the average treatment effect (ATE) using the mixed Ordinary Least Squares (OLS) weighted regression for the panel data. P=p(D=t(Z) | Z) is selected among the four propensity scores of each individual, where t(Z) is the group in which the individual Z is located; for example, if the individual Z is a male-to-female CEO succession, then t(Z)=2. The regression uses the sampling weight 1/P, which is the reciprocal of the probability that the individual enters the group in which he/she is located. To test hypothesis 1, we established a weighted regression model, as follows:

$$IMROA = \alpha_0 + \alpha_1 MF + \alpha_2 FM + \alpha_3 FF + \alpha_4 PRE\_ADROA + \alpha_5 FIRM\_SIZE + \alpha_6 FIRM\_AGE + \alpha_7 DA\_RAT + \alpha_8 IND\_DIRE + \alpha_9 FE\_BOARD\_RAT + \alpha_{10} SOE + \alpha_{11} SUC\_DUAL + \alpha_{12} SUC\_OWN + \alpha_{13} SUC\_AGE + \alpha_{14} YEAR + \alpha_{15} INDUSTRY + \varepsilon \quad (1)$$

The meaning of $\alpha_1$ is: pairwise ATE of male-to-female CEO succession (t=2) compared with male-to-male CEO succession (t=1). $\alpha_1$ = Pairwise $ATE_{2,1}$ = E(Y[2] − Y[1]) = E(Y[2]) − E(Y[1]), where Y[t] indicates the potential results when the individual enters D=t(t= 1, 2, 3, 4); the expectations are defined on population. Thus, this pairwise ATE represents the overall average result of the male-to-female CEO succession minus the result of the male-to-male CEO succession. In the same way, $\alpha_2$ compares female-to-male with male-to-male, and $\alpha_3$ compares female-to-female with male-to-male.

To compare three categories other than male-to-male, such as male-to-female and female-to-male, we only need to subtract the coefficients: $\alpha_1 - \alpha_2$ = Pairwise $ATE_{2,3}$ = E(Y[2]) − E(Y[1] ) − [ E(Y[3]) − E(Y[1]) ] = E(Y[2]) −

E(Y[3]). In the same way, $\alpha_1 - \alpha_3$ is male-to-female minus female-to-female, and $\alpha_2 - \alpha_3$ is female-to-male minus female-to-female.

### *4.6. Estimation of Moderating Effects*

To test Hypothesis 2 and 3, we established the weighted regression Equations 2 and 3, respectively.

$$IMROA = \alpha_0 + \alpha_1 MF + \alpha_2 FM + \alpha_3 FF + \alpha_4 MF \times SUC\_DUAL + \alpha_5 FM \times SUC\_DUAL + \alpha_6 PRE\_ADROA + \alpha_7 FIRM\_SIZE + \alpha_8 FIRM\_AGE + \alpha_9 DA\_RAT + \alpha_{10} IND\_DIRE + \alpha_{11} FE\_BOARD\_RAT + \alpha_{12} SOE + \alpha_{13} SUC\_DUAL + \alpha_{14} SUC\_OWN + \alpha_{15} SUC\_AGE + \alpha_{16} YEAR + \alpha_{17} INDUSTRY + \varepsilon \quad (2)$$

And

$$IMROA = \alpha_0 + \alpha_1 MF + \alpha_2 FM + \alpha_3 FF + \alpha_4 MF \times SOE + \alpha_5 FM \times SOE + \alpha_6 PRE\_ADROA + \alpha_7 FIRM\_SIZE + \alpha_8 FIRM\_AGE + \alpha_9 DA\_RAT + \alpha_{10} IND\_DIRE + \alpha_{11} FE\_BOARD\_RAT + \alpha_{12} SOE + \alpha_{13} SUC\_DUAL + \alpha_{14} SUC\_OWN + \alpha_{15} SUC\_AGE + \alpha_{16} YEAR + \alpha_{17} INDUSTRY + \varepsilon \quad (3)$$

## 5. RESULTS

### *5.1. Preliminary Analysis*

Descriptive statistics are presented in Table 2.

In the 4,338 CEO succession observations, 205 were male-to-female, 200 were female-to-male and only 21 were female-to-female. The improvement of firm performance in male-to-male CEO succession IMROA is 0.020, which is larger than the mean value of IMROA for other samples, especially male-to-female and female-to-male successions. Therefore, there may exist differences among those four categories, in line with our expectations.

**Table 2.** Descriptive statistics (Means and standard deviations).

| Variables | Total | Male-to-male succession | Male-to-female succession | Female-to-male succession | Female-to-female succession |
|---|---|---|---|---|---|
| IMROA | 0.016<br>(1.010) | 0.020<br>(1.063) | -0.021<br>(0.118) | -0.026<br>(0.156) | 0.016<br>(0.063) |
| SUC_DUAL | 0.880<br>(0.325) | 0.880<br>(0.325) | 0.902<br>(0.297) | 0.855<br>(0.354) | 0.762<br>(0.436) |
| SOE | 0.555<br>(0.497) | 0.568<br>(0.495) | 0.429<br>(0.496) | 0.455<br>(0.499) | 0.333<br>(0.483) |
| PRE_ADROA | -0.017<br>(0.135) | -0.017<br>(0.138) | -0.020<br>(0.125) | -0.010<br>(0.092) | -0.003<br>(0.057) |
| FIRM_SIZE | 21.597<br>(1.380) | 21.617<br>(1.390) | 21.404<br>(1.357) | 21.438<br>(1.239) | 21.271<br>(0.900) |
| FIRM_AGE | 2.443<br>(0.487) | 2.440<br>(0.485) | 2.462<br>(0.497) | 2.464<br>(0.523) | 2.636<br>(0.365) |
| DA_RAT | 0.849<br>(13.654) | 0.866<br>(14.318) | 0.902<br>(5.737) | 0.515<br>(0.306) | 0.475<br>(0.265) |
| IND_DIRE | 0.341<br>(0.097) | 0.340<br>(0.097) | 0.347<br>(0.093) | 0.344<br>(0.102) | 0.354<br>(0.090) |
| FE_BOARD_RAT | 0.133<br>(0.134) | 0.121<br>(0.128) | 0.250<br>(0.138) | 0.225<br>(0.142) | 0.278<br>(0.123) |
| SUC_OWN | 0.011<br>(0.055) | 0.011<br>(0.054) | 0.012<br>(0.053) | 0.014<br>(0.065) | 0.015<br>(0.060) |
| SUC_AGE | 45.684<br>(6.789) | 45.789<br>(6.771) | 44.419<br>(6.649) | 45.090<br>(6.795) | 44.571<br>(9.667) |
| Number of observations | 4338 | 3912 | 205 | 200 | 21 |

**Note:** The means are parallel to the variable names, and the standard deviations are in parentheses.

Propensity Scores were estimated with the use of the twang package in R designed by McCaffrey et al. (2013) to run the GBM algorithm. The covariate balance indicator contained in the function effect size converged after 3,000 iterations to find the minimum value in the four categories (which means balance optimization).

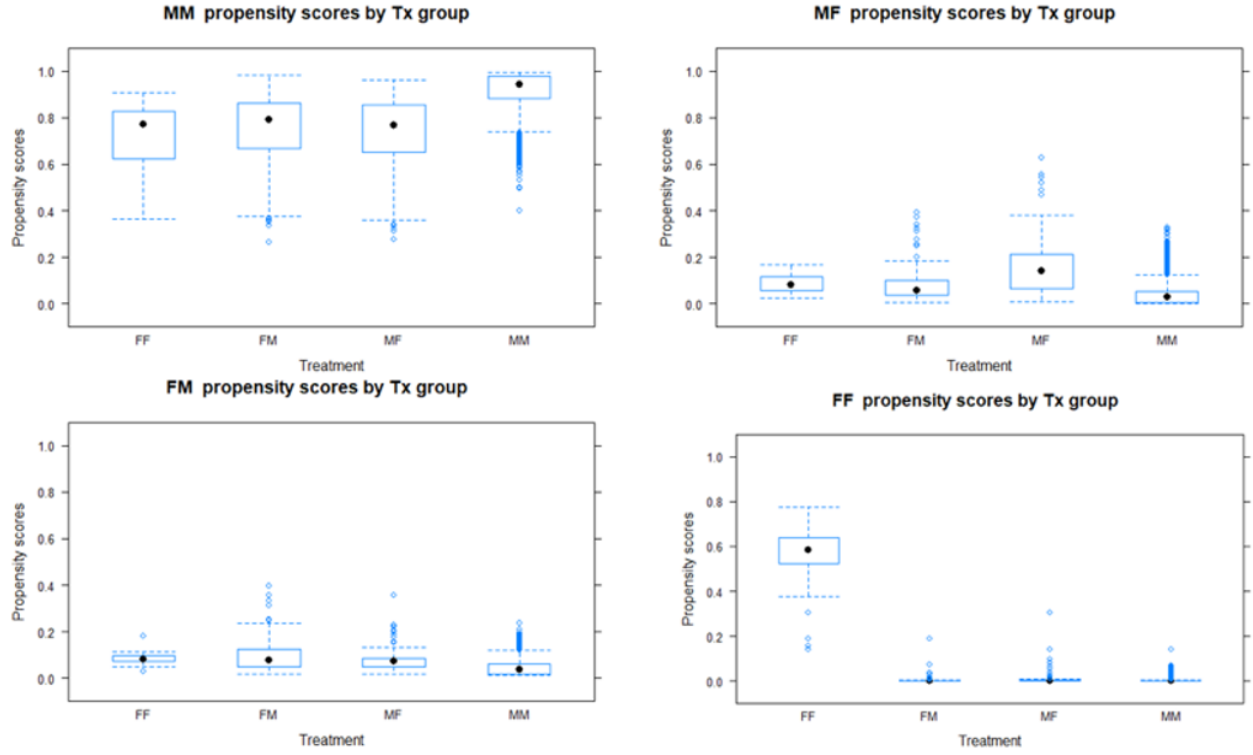


**Figure 1.** Overlap indicator probability distribution plots.

The Propensity Score method requires that each sample has a probability to enter a different category, thus demanding a level of overlap. We estimated the propensity score distribution of the four categories Figure 1, such as the graph in the upper left corner, showing the probability distribution that the samples in the four categories enter the male-to-male CEO succession category p(z)=p(D=1 | Z). Although a box that is too narrow, such as in the graph in the lower right corner, does not necessarily indicate that the covariates are poorly balanced, generally the wider the box the better the balance (Griffin, McCaffrey, Almirall, Burgette, & Setodji, 2017). As seen in Figure 1, the overlap between the male-to-male, the male-to-female and the female-to-male CEO succession samples meet the requirements, but the female-to-female CEO succession sample's overlap is not ideal because the female-to-female CEO successions are too rare in the market, and the number of observations is too small, which may cause some bias in our study.

### *5.2. Hypothesis Testing*

We utilized the Propensity Score Estimation for multiple treatments to calculate the weight = 1/p(D=t(Z)| Z), and then we utilized the mixed OLS weighted regression on the panel data to calculate the pairwise ATEs. The results are presented in Tables 3 and 4. As mentioned above, t = 1, 2, 3, 4 represent male-to-male, male-to-female, female-to-male, female-to-female CEO successions, respectively. $ATE_{t,t'} = E(Y[t] - Y[t'])$; that is, the difference between the average effect of t and the average effect of t'.

As seen in Equation 1 Table 3, $ATE_{2,1} = -0.021$ ($p < 0.05$), which means that the male-to-female CEO succession hurt firm performance compared with the male-to-male CEO succession. $ATE_{3,1} = -0.014$ ($p < 0.05$), which means that the female-to-male CEO succession hurt firm performance compared with the male-to-male CEO succession.

And $ATE_{4,1} = 0.017$ ($ns$), which means that the impact on firm performance of female-to-female and male-to-male CEO successions was not different.

**Table 3.** The results of the mixed OLS weighted regression.

| Predictor | IMROA | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| MF | -0.021** | -0.113*** | -0.020 |
| | (-2.11) | (-2.87) | (-1.19) |
| FM | -0.014** | -0.015 | -0.030*** |
| | (-2.02) | (-0.72) | (-2.59) |
| FF | 0.017 | 0.015 | 0.016 |
| | (1.22) | (1.09) | (1.16) |
| MF× SUC_DUAL | | 0.098** | |
| | | (2.44) | |
| FM× SUC_DUAL | | 0.000 | |
| | | (-0.01) | |
| MF× SOE | | | -0.003 |
| | | | (-0.16) |
| FM× SOE | | | 0.030** |
| | | | (2.11) |
| PRE_ADROA | -0.750*** | -0.743*** | -0.746*** |
| | (-9.50) | (-9.35) | (-9.75) |
| FIRM_SIZE | 0.005* | 0.006* | 0.006* |
| | (1.74) | (1.86) | (1.76) |
| FIRM_AGE | -0.010 | -0.009 | -0.010 |
| | (-0.95) | (-0.90) | (-0.96) |
| DA_RAT | -0.015 | -0.014 | -0.014 |
| | (-0.87) | (-0.85) | (-0.77) |
| IND_DIRE | 0.061 | 0.054 | 0.062 |
| | (1.40) | (1.26) | (1.42) |
| FE_BOARD_RAT | -0.019 | -0.008 | -0.018 |
| | (-0.69) | (-0.31) | (-0.66) |
| SOE | 0.005 | 0.006 | -0.003 |
| | (0.78) | (0.85) | (-0.49) |
| SUC_DUAL | 0.005 | -0.007 | 0.004 |
| | (0.44) | (-1.14) | (0.39) |
| SUC_OWN | 0.029 | 0.036 | 0.031 |
| | (0.53) | (0.69) | (0.56) |
| SUC_AGE | 0.000 | 0.000 | 0.000 |
| | (0.22) | (0.05) | (0.27) |
| Constant | -0.121* | -0.116* | -0.123* |
| | (-1.86) | (-1.78) | (-1.88) |
| Year | Control | Control | Control |
| Industry | Control | Control | Control |
| $N$ | 4338 | 4338 | 4338 |
| R-squared | 0.3031 | 0.3111 | 0.3071 |

**Note:** t-value in parentheses; * p<0.10; ** p<0.05; *** p<0.01 (two-tailed significance).

Table 4 depicts the relationship of the other three gender combinations. $ATE_{2,3} = -0.007$ ($ns$), suggesting no difference between male-to-female and female-to-male CEO successions. $ATE_{2,4} = -0.037$ ($p < 0.05$), which suggests that male-to-female CEO succession damages firm performance compared to female-to-female CEO succession. And $ATE_{3,4} = -0.031$ ($p < 0.05$), indicating that female-to-male CEO succession damages firm performance compared to female-to-female CEO succession.

**Table 4.** The relationship between male-to-female, female-to-male and female-to-female CEO successions.

| Estimate | $ATE_{2,3}$ (MF-FM) | $ATE_{2,4}$ (MF-FF) | $ATE_{3,4}$ (FM-FF) |
|---|---|---|---|
| Coef. | -0.007 | -0.037** | -0.031** |
| t | (-0.56) | (-2.54) | (-1.99) |

**Note:** ** p<0.05 (two-tailed significance).

According to the results of the above pairwise ATEs, male-to-female and female-to-male CEO successions are negatively linked with firm performance compared with male-to-male and female-to-female CEO successions. There is no significant difference between male-to-female and female-to-male successions, nor between male-to-male and female-to-female successions. That is to say, the findings show that the damage to firm performance is caused by the successions of CEOs with different gender rather than by CEO gender. These results, therefore, lend support to Hypothesis 1.

Equations 2 and 3 (Table 3) show the results of the testing for moderating effects.

Equation 2 shows that the impact of CEO power on the relationship between male-to-female CEO succession and firm performance is to weaken the effect ($p < 0.05$). That is to say, the greater the power of female successor, the smaller the negative impact of male-to-female CEO succession on firm performance. On the other hand, the role of CEO power in regulating the relationship between female-to-male CEO succession and firm performance is not significant. These results lend support to Hypothesis 2.

Equation 3 (Table 3) suggests that the state-owned nature of the firm weakens the relationship between female-to-male CEO succession and firm performance ($p < 0.05$). That is to say, the negative impact of the female-to-male CEO succession on firm performance in state-owned enterprises is smaller than that in private enterprises. The impact of state-owned nature on the relationship between male-to-female CEO succession and firm performance was not significant. These results lend support to Hypothesis 3.

### *5.3. Robustness Analysis*

In order to enhance confidence in the reliability of the results, we tested the robustness of the main effect. For this reason, we re-run the analysis with a modified firm performance indicator, IMROA_RB, which was calculated as follows (Zhang & Qu, 2016):

$$IMROA\_RB = POST\_ROA\_RB - PRE\_ROA\_RB,$$

Where, PRE_ROA_RB is the average ROA for the two half years before the CEO succession, and POST_ROA_RB is the average ROA for the two half years after the CEO succession.

Because most of the half year results were lacking for the years 2001 to 2003, the number of observations decreased to 3,089, which contained 144 male-to-female, 141 female-to-male, and 18 female-to-female CEO successions.

The results (available in full detail from the authors) were as follows: $ATE_{2,1} = -0.008$ ($p < 0.05$); $ATE_{3,1} = -0.010$ ($p < 0.05$); $ATE_{4,1} = 0.008$ (*ns*). In addition to male-to-male CEO succession, $ATE_{2,3} = 0.002$ (*ns*), $ATE_{2,4} = -0.017$ ($p < 0.05$), and $ATE_{3,4} = -0.019$ ($p < 0.05$).

These results were no different from those of the main analysis: male-to-female and female-to-male CEO successions were negatively related to firm performance compared with male-to-male and female-to-female successions. There was no significant difference between male-to-female and female-to-male, neither between male-to-male and female-to-female successions. The additional analysis, therefore, reiterates that the damage to firm performance is caused by the succession of CEOs with different gender rather than female CEOs *per se*, indicating that the results of the main analysis are robust.

## 6. DISCUSSION

The "glass ceiling" is a term that is utilized to describe the obstacles that women encounter when they are to reach the top level (Morrison, White, & Van Velsor, 1987). With the progress of systems and culture, more women have become senior executives. Our study explores what happens after a woman has broken the "glass ceiling" and has become a CEO. The issue of CEO gender and how it relates to firm performance has been the focus of strong discussion and research with equivocal findings thus far. In the present work, we took a different perspective looking at whether the gender of the new CEO is the same or different from that of the predecessor and how this relates to subsequent firm performance. We utilized data from all Chinese listed companies from 2001 to 2016. To clearly show the impact of the different gender combinations in CEO succession (male-to-male, male-to-female, female-to-male, female-to-female), we utilized the *Propensity Score Estimation for Multiple Treatments*.

What we found was that male-to-female and female-to-male CEO succession was negatively related to firm performance compared with male-to-male and female-to-female CEO succession. There was no significant difference between male-to-male and female-to-female successions. The pattern of results indicates that it is CEO succession with different gender that hurts firm performance, not merely the female CEO.

As we noted, this could be caused by differences in leadership styles and preferences between men and women, and/or changes in the functioning of the management team that the new CEO may enact, which may lead to disruptions in the internal environment of the firm. Furthermore, according to the social identity theory (Tajfel & Turner, 1986), CEOs with different gender are likely to be rejected or doubted at the beginning by the internal group, thus reducing team efficiency and harming firm performance.

The findings also suggested that the power of the successor can mitigate the negative impact of male-to-female CEO succession on firm performance, but this does not hold for female-to-male CEO succession. This implies that compared with males, female successors need more power to control the internal environment, increase their prestige and acceptance, and enhance the efficiency of team strategy implementation.

What we also found was that the state-owned nature of the firm can weaken the negative impact of female-to-male CEO succession on firm performance, but it does not do so for male-to-female CEO succession. This implies, as we discussed in the hypothesis development part, that in state-owned enterprises, male-to-female CEO succession may be perceived as a deviation from "normality", while female-to-male CEO succession is considered as an event that brings the situation back to "normality".

The contribution of this study is reflected in the following four aspects.

First, it enriches research in the subject of CEO succession. The direction of combining gender with CEO succession events is novel, especially in the Chinese context. By studying the relationship between the gender combination in CEO succession and firm performance, our study clarifies that it is the change in gender in CEO succession rather the new CEO gender *per se* that influences firm performance.

Second, our study supplements work on female executives. Extant studies typically focus only on the gender of CEOs or other executives. This paper links predecessor to successor and provides a novel perspective in the literature of corporate governance and leadership. Considering that male CEOs compose the overwhelming majority in the market, if a CEO with different gender takes over, there is a high probability that it comes to a female successor. Based on the results of this study, to avoid disruption in the internal environment that hurts performance, companies may operate under the incentive not to choose a successor with different gender. This is a supplementary explanation for the numerical disadvantage of female CEOs.

Third, we identified factors that can mitigate the negative effect of CEO succession with different gender, which can serve as guidance for practice. For the male-to-female CEO succession, the board of directors and the senior management team should actively cooperate with female successors and give them more power to better control the internal environment, so as reduce the disruption caused by the succession.

Fourth, the propensity score method is typically utilized for two categories of data, such as male or female. Our study applied it to the four gender combinations of CEO succession, thus extending the practice of this method.

## 7. LIMITATIONS AND FUTURE RESEARCH

The study has certain limitations that direct towards future research.

The quantity imbalance of female CEOs could have biased to some extent the results. This, however, is a global phenomenon, and as seen China has a rather large percentage of female CEOs in comparison to most other countries. Nonetheless, in the future researchers could consider the possibility of compiling data from multiple countries in order to have greater gender balance.

We utilized return on assets (ROA) as measure of firm performance, which is one of the most accepted and widely utilized such indicators. However, future studies could utilize different indicators of performance, which can include value indicators such as the Tobin Q. Multiple studies with various performance indicators will increase confidence on the generalizability of the results.

Finally, in this study we utilized large-scale panel data. Such data were appropriate for our purposes because they could provide reliable responses to our research questions. However, this type of data may not be able to provide in-depth explanations of the processes that take place during and after the CEO succession (for example, how the internal environment changes) that lead to outcomes (Bozionelos, 2014). Hence, micro-level studies (drawing, for example, from psychology and behavioral finance) could help in this respect.

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