Female CEOs and Investment Efficiency in the Vietnamese Market

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Abstract

This paper proposes female CEOs' overconfidence and risky behavior stem from gender stereotype threats. With two subsamples in Vietnam—firms in the Northern and Southern regions–we empirically show that female CEOs in the North, where there is less gender stereotype, tend to overinvest relative to male CEOs. However, in the South, they are indifferent. Additional analysis reinforces the main finding that female CEOs from the North tend to take more risks even when dealing with market volatility and uncertainty (e.g., the COVID-19 pandemic). Such risky behaviors of female CEOs in the North do not deteriorate firm value but instead, possibly improve firm performance.

JEL classification: G30, G32, J16

Keywords: female CEOs, Vietnam, gender, stereotype

1. Introduction

Women in leadership tend to exhibit lower levels of overconfidence and less willingness to take excessive risks or exploit opportunities for personal gain (Bernasek and Shwiff, 2001; Abou-el-sood, 2018; Adhikari et al., 2019). Therefore, female CEOs are likely to be risk-averse and make conservative decisions (Palvia et al., 2015; Faccio,2006; Zeng and Wang, 2015; Skala and Weill, 2018). Previous studies document that female CEOs help reduce asymmetric information and agency conflicts (Chen et al., 2018). Also, they engage in positive leadership, leading to a strong leadership structure and enhanced corporate investment decisions (Frye and Pham, 2018). For example, Adams and Ferreira (2009) show that female CEOs actively monitor firm operations, resulting in positive firm performance. Also, Faccio (2006) examine how a female CEO significantly reduces a firm's idiosyncratic risk. Khan and Vieito (2013) argue that firms with female CEOs perform better due to lower leverage and capital expenditure as well as higher earnings quality, returns on assets, and tangibility than firms with male CEOs. In a similar line of studies, Cimini (2022) documents that female presence on corporate boards increases the value relevance of accounting amounts, suggesting that board composition affects investors' judgments.

However, many previous studies do not consider the environmental factors that can drive female CEOs' risk aversion. For example, Berger et al. (2014) find that women tend to trade excessively and engage in more risk-taking activities than men in the financial sector, one of the most male-dominated industries (Ryan et al., 2016; Fender et al., 2016). The mixed findings on women's risk-taking behavior imply that biological gender may not play a role in risk aversion; the difference may stem from external factors such as education and culture. For example, Booth and Nolen (2012) find that students at co-education schools do not show significantly different investment behavior based on gender, while Carr and Steele (2010) empirically show that stereotypes influence investment behavior for males and females. Based on this finding, female CEOs may respond differently depending on cultural gender expectation

or stereotypes.

Vietnam provides an ideal setting to examine the influence of culture on female CEOs' risk-taking behavior due to its cultural separation of the North and South,[1] while the education system is the same across the country (United Nations Development Program (UNDP), 2015). The gender stereotypes in Northern and Southern Vietnam differ because of the country's division into two regions by political systems before the Vietnam War ended in 1975: communism/socialism in the North and capitalism in the South. Different political ideology leads to variations in societal gender stereotypes, and the effect is long-lasting (e.g., Alesina and Fuchs–Schündeln, 2007; Bauernschuster and Rainer, 2012; Lippmann et al., 2020). According to Anderson (2010), the communist North challenges traditional gender roles, with women participating in the war and other professions. However, the capitalist South's markers of freedom include focusing on Western gender norms like 'miniskirts' and '[driving] Honda motorcycles' (Eisen, 1984).

Since unification, Vietnam has committed to promoting gender equality (United Nations (UN) Women, 2016). Vietnam currently ranks first worldwide regarding female representation in the workforce and political participation. However, regional differences between the North and South persist (Goodkind, 1996; Truong et al., 1997; Bélanger, 2000; Ghuman et al., 2006), with a smaller gender gap in the North (General Statistics Office, 2015). A stereotype threat is a fear of being seen and judged according to a negative group stereotype. Thus, in a severely unequal gender environment, women may feel pressured to hold back and be less confident.

In addition, leaders in Northern and Southern Vietnam exhibit different management styles due to their geographical separation. According to Ralston et al. (1999), managers in the North show a Western orientation of individualism and competitiveness (Hui and Triandis, 1986), while the South displays a more collectivist approach, prioritizing group goals over personal ones (Triandis et al., 1986). Thus, this paper explores whether female CEOs exhibit different risk-taking behaviors due to variations in gender stereotypes and managerial individualism between the North and South regions.

To test this, we split the sample into Northern and Southern firms to examine risk-taking differences between female and male CEOs. Our findings empirically show that female CEOs in both regions overinvest relative to male CEOs. However, the coefficient degree differs by 3.5 times, and the statistical significance disappears for the South with different measurements of investment efficiency, while, in the North, the results based on alternative measures are statistically significant and consistent with the main findings.

To further check if female CEOs in the North take more risks than male CEOs, we examine two risky environments for firms: high market volatility and COVID-19. Firms with female CEOs and high volatility tend to overinvest, indicating overconfidence in their decision-making abilities. Furthermore, during COVID-19, female CEOs overinvest relative to male CEOs in the Northern region. Overall, the results suggest that Vietnamese female CEOs tend to take more risks and are less driven by stereotype threats, allowing them to act more freely.

This study contributes to the literature in two ways. First, the empirical evidence enriches the extant literature on female CEO risk-taking (e.g., Powell and Ansic, 1997; Bajtelsmit and Bernasek, 1996; Barber and Odean, 2001; Berger et al., 2014; Palvia et al., 2015; Faccio, 2006) by showing that female CEOs may not be biologically risk-averse relative to male CEOs. Second, the main findings propose that stereotype threats are a possible factor pressuring female CEOs to be risk-averse (e.g., Alesina and Fuchs–Schündeln, 2007; Anderson, 2010; Bauernschuster and Rainer, 2012; Low et al., 2015; Lippmann et al., 2020). Thus, this research suggests studying environmental factors, such as gender stereotypes, alongside correlations between female leadership and firm outcomes to analyze female leaders' effectiveness or behaviors. Lastly, our findings add to the studies on investment efficiency as they imply that female CEOs positively influence firm investment efficiency. For instance, Boubaker et al. (2018) show that audit quality positively impacts corporate investment efficiency. In addition, Boubaker et al. (2022) document that as competition increases bankruptcy risk, it leads managers to underinvest in labor to avoid incurring labor-related costs.

The remainder of this paper is structured as follows. Section 2 discusses the data and sample, Section 3 presents the main findings, and Section 4 discusses additional tests. Finally, Section 5 provides a conclusion.

2. Data and sample

2.1. Sample

Our initial sample comprises all Vietnamese firms available on the Thomson–Reuters Worldscope Database from 2015 to 2021. Using this database, we hand-collect CEO information and create a dummy variable equal to 1 if the CEO is female and 0 otherwise. All firm-level accounting data are from Thomson-Reuters Worldscope and Datastream. Our study's firm-level control variables only include firms with no missing information. Finally, by removing financial firms (SIC codes 6000–6999), we have a final sample of 5420 firm-year observations and 1270 firms from 2015 to 2021.

2.2. Variable construction

2.2.1. Investment efficiency

While we test three different investment efficiency measures, the primary investment efficiency variable comes from Chen et al. (2011), as their measurement incorporates McNichols and Stubben's (2008) argument that the relationship between investment and revenue growth can differ between revenue increases and decreases. Their study uses the following model to capture investment

[1] According to Do et al. (2023), "It is commonly believed that there is a regional difference in gender role attitudes between people of Northern and Southern Vietnam."

efficiency:

$$Investment_{i,t} = \alpha + \beta_1 Neg_{i,t-1} + \beta_2 Revenue\ Growth_{i,t-1} + \beta_3 Neg_{i,t-1} * Revenue\ Growth_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where $Investment_{i,t}$ is the growth in total assets and $Neg_{i,t-1}$ equals 1 if the previous year's revenue growth rate is negative and 0 otherwise. $RevenueGrowth_{i,t-1}$ indicates the previous year's annual revenue growth rate. The interaction term $Neg_{i,t-1}$ and $RevenueGrowth_{i,t-1}$ follow Chen et al. (2011), and the residual $\varepsilon_{i,t}$ reflects the deviation from the expected level of investment at the industry level. The model's estimate is cross-sectional for each industry (three-digit SIC code). A positive (negative) residual indicates overinvestment (underinvestment) relative to the revenue growth as the investment is higher (lower) than the expected level.

The other two alternative investment efficiency proxy measures are from Biddle et al. (2009), based on sales growth, and Chen et al. (2013), based on Tobin's Q and sales growth. Biddle et al. (2009) model is:

$$Investment_{i,t} = \alpha + \beta_1\ Revenue\ Growth_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

where $Investment_{i,t}$ is the growth in total assets and $RevenueGrowth_{i,t-1}$ indicates the previous year's annual revenue growth rate. Chen et al. (2013) model is:

$$Investment_{i,t} = \alpha + \beta_1 Q_{i,t-1} + \beta_2 Revenue\ Growth_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

where $Investment_{i,t}$ is the growth in total assets and $Q_{i,t-1}$ is the firm performance measure of Tobin's Q (calculated as (market capitalization + total liabilities) / (common equity + total liabilities)). $RevenueGrowth_{i,t-1}$ indicates the previous year's annual revenue growth rate. Consistent with our main model, the residuals capture CEOs' over- and under-investments.

2.2.2. Female CEOs

Due to limited data availability on Vietnamese firm leaders, we hand-collect information on CEOs by visiting each firm's website. For our sample period of 2015–2021, we assume the CEO is male if CEO information is unavailable.[2] The dummy variable *Female_CEO* equals 1 if the CEO is female in a given year and 0 otherwise. We define Northern and Southern managers based on the location of firms' headquarters, provided by WorldScope (Item 6023). The list of cities and their divisions used in this paper is provided in Appendix A.

2.2.3. Controls

Firm-specific financial informationon international firms is from WorldScope and Datastream. Following the previous literature, such as Biddle and Hilary (2006) and Biddle et al. (2009), we control for firm-specific characteristic variables, including the natural logarithm value of a firm's market capitalization (*Size*), book-to-market value (*BTM*), return on equity (*ROE*), the total debt ratio (*Leverage*), the ratio of the amount of cash held to the book value of assets (*CASH*), the annual growth of sales (*Investment_Opportunity*), the annual standard deviation of monthly stock returns (*Volatility*), and the proportion of closely-held shares (*CLOSE*). Table 1 presents the summary statistics of the dependent and independent variables.

3. Main results

3.1. Baseline findings

To check the risk-taking behavior of female CEOs, we use the following equation:

$$Inv\_Eff_{i,t} = \alpha + \beta_1\ Female\_CEO_{i,t} + \beta_2 X_{i,t} + \Phi_{industry} + \theta_t + \varepsilon_{i,t} \quad (4)$$

where the indices i and t correspond to firm and year, respectively. $Inv\_Eff_{i,t}$ represents firms' investment efficiency. $Female\_CEO_{i,t}$ equals 1 if the CEO is female and 0 otherwise. $X_{i,t}$ represents control variables, including *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close,* while $\Phi_{industry}$ and θ_t represent industry- and year-fixed effects. Finally, $\varepsilon_{i,t}$ represents the firm time-specific error term clustered at the firm level.

The regression results are shown in Table 2. Model (1) shows the results before splitting the sample into North and South. The coefficient for *Female_CEO* is positive and statistically significant, indicating that female Vietnamese CEOs overinvest across the country. When splitting the sample into North and South in Models (2) and (3), respectively, *Female_CEO* is positive and statistically significant in both columns. However, the size and statistical significance are much more noticeable in Model (2) for the Northern region.[3] Overall, the results imply that female CEOs in the Northern region—where gender stereotypes against women are less prevalent—exhibit greater confidence and tend to overinvest.

[2] Out of 1,270 firms, we can only hand-collect CEO gender information from 1,026 firms.

[3] The coefficient difference test for *Female_CEO* between Models (2) and (3) for *Female_CEO_hat* has an F-value (1, 791) equal to 3.15 and a p-value equal to 0.0761.

Table 1
Summary statistics.

	Observations	Mean	Std	P1	P25	Median	P75	P99
Inv_Eff	5240	−0.055	0.942	−2.908	−0.146	−0.040	0.084	1.750
Female_CEO	5240	0.035	0.185	0.000	0.000	0.000	0.000	1.000
Size	5240	16.368	1.855	12.708	15.093	16.223	17.451	21.877
BTM	5240	1.427	2.710	0.135	0.612	1.000	1.603	7.378
ROE	5240	0.060	0.923	−0.811	0.026	0.089	0.162	0.533
Leverage	5240	0.218	0.189	0.000	0.034	0.190	0.358	0.669
Cash	5240	0.148	0.162	0.001	0.030	0.089	0.210	0.717
Invop	5240	0.286	4.509	−0.866	−0.129	0.034	0.186	3.731
Volatility	5240	0.128	0.088	0.028	0.071	0.108	0.161	0.441
Close	5240	0.390	0.318	0.000	0.000	0.422	0.658	0.981

Table 2
Baseline findings.

Variables	(1) *Inv_Eff*	(2) *Inv_Eff*	(3) *Inv_Eff*
Female_CEO	0.114**	0.286***	0.089*
	(2.33)	(2.85)	(1.84)
Size	0.027***	0.039***	0.022**
	(3.70)	(3.88)	(2.05)
BTM	−0.013***	−0.008	−0.014***
	(−6.00)	(−1.16)	(−11.13)
ROE	0.013	0.007	0.018
	(1.59)	(0.98)	(1.18)
Leverage	0.045	0.066	−0.013
	(0.54)	(0.64)	(−0.09)
Cash	0.071	−0.007	0.109
	(0.78)	(−0.06)	(0.97)
Invop	0.026	0.003	0.078***
	(1.32)	(1.13)	(3.70)
Volatility	0.319**	0.332	0.070
	(2.14)	(1.42)	(0.35)
Close	−0.011	−0.024	−0.032
	(−0.28)	(−0.47)	(−0.64)
Industry-Fixed Effect	Yes	Yes	Yes
Year-Fixed Effect	Yes	Yes	Yes
Observations	5240	2317	2350
R-squared	0.039	0.033	0.114

This table presents the regressions of the *Female_CEO* variable on the investment efficiency variable, *Inv_Eff*. The firm-level controls are *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close.* The results are from regressions with industry- and year-fixed effects. The values of the t-statistics in parentheses use robust standard errors clustered at the firm level. Model (1) includes all samples of Vietnamese firms, while Models (2) and (3) report the results for the Northern and Southern samples, respectively.

3.2. Alternative investment efficiency variables

Using Biddle et al. (2009) model, we extract an alternative investment efficiency measure, *Inv_Eff_A*, and regress it with *Female_CEO* as our baseline finding. Models (1) to (3) of Table 3 show that the variable *Inv_Eff_A* produces insignificant coefficients for *Female_CEO* in the full and Southern firm samples.[4] *Female_CEO* has a positive and statistically significant coefficient only for the Northern sample, supporting our main finding that female CEOs in the North are overconfident and overinvest due to less prevalent gender stereotypes.

Furthermore, applying Chen et al. (2013) model and an alternative investment efficiency variable, *Inv_Eff_B*, we obtain identical findings to those of *Inv_Eff_A* in Models (4) to (6) of Table 3. The overall results indicate that the threat of gender stereotypes influences female CEOs' risk-taking actions.[5]

3.3. The subsequent effects of female CEOs

In this section, we lag all the independent variables to check for any further effects of female CEOs on investment efficiency. Table 4 shows that the lag of *Female_CEO* is only statistically significant in Model (2), the Northern region sample. This result strengthens our main finding that female CEOs exhibit overconfidence, especially in societies that define gender roles less rigidly.

[4] The coefficient difference test of *Female_CEO* between Models (2) and (3) for *Female_CEO_hat* is F-value (1, 791) = 3.27, p-value=0.0709.
[5] The coefficient difference test of *Female_CEO* between Models (5) and (6) for *Female_CEO_hat* is F-value (1, 782) = 4.03, p-value=0.0452.

Table 3
Alternative measures of investment efficiency.

Variables	(1) *Inv_Eff_A*	(2) *Inv_Eff_A*	(3) *Inv_Eff_A*	(4) *Inv_Eff_B*	(5) *Inv_Eff_B*	(6) *Inv_Eff_B*
Female_CEO	0.042	0.154**	0.013	0.028	0.136**	−0.005
	(1.29)	(2.24)	(0.34)	(1.02)	(2.07)	(−0.20)
Size	0.028***	0.036***	0.019***	0.026***	0.033***	0.019***
	(6.31)	(5.03)	(3.45)	(6.70)	(5.21)	(3.82)
BTM	−0.005***	−0.007	−0.004***	−0.005***	−0.002	−0.005***
	(−3.46)	(−1.40)	(−4.76)	(−5.30)	(−0.63)	(−6.19)
ROE	0.015*	0.010	0.017	0.015*	0.009	0.019
	(1.87)	(1.33)	(1.28)	(1.90)	(1.14)	(1.57)
Leverage	0.147***	0.081	0.188***	0.149***	0.096	0.186***
	(3.28)	(1.16)	(3.54)	(3.82)	(1.51)	(4.12)
Cash	0.111**	0.123	0.118**	0.042	0.073	0.028
	(2.16)	(1.51)	(2.19)	(0.96)	(1.13)	(0.55)
Invop	0.033	0.003	0.104***	0.033	0.004	0.111***
	(1.20)	(0.79)	(2.98)	(1.19)	(1.06)	(3.20)
Volatility	0.401***	0.405**	0.192	0.381***	0.446**	0.114
	(3.44)	(2.01)	(1.18)	(3.38)	(2.25)	(0.74)
Close	0.001	0.027	−0.021	−0.017	0.012	−0.026
	(0.07)	(0.82)	(−0.82)	(−1.00)	(0.49)	(−1.18)
Industry-Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5240	2317	2350	5102	2248	2301
R-squared	0.137	0.083	0.433	0.177	0.105	0.518

This table presents the regressions of the *Female_CEO* variable on the alternative investment efficiency variables of *Inv_Eff_A* and *Inv_Eff_B*. The firm-level controls are *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close.* The results are from regressions with industry and year-fixed effects. The values of the t-statistics in parentheses are from the robust standard errors clustered at the firm level. Models (1) to (3) report the results of the Northern sample, while Models (4) to (6) show the results of the Southern sample.

Table 4
Subsequent effects.

Variables	(1) *Inv_Eff*	(2) *Inv_Eff*	(3) *Inv_Eff*
L.*Female_CEO*	−0.009	0.317***	0.089
	(−0.07)	(2.60)	(1.44)
L.*Size*	−0.055	0.029**	0.008
	(−0.81)	(2.53)	(0.60)
L.*BTM*	−0.053	−0.012	−0.031
	(−1.35)	(−1.24)	(−1.55)
L.*ROE*	−0.074	0.002	−0.174***
	(−1.40)	(0.38)	(−10.07)
L.*Leverage*	−0.554	−0.156	−0.226
	(−1.41)	(−1.55)	(−1.29)
L.*Cash*	−0.202	−0.176	−0.029
	(−1.06)	(−1.03)	(−0.20)
L.*Invop*	−0.001	−0.001	0.002
	(−0.56)	(−0.48)	(0.62)
L.*Volatility*	−0.512	0.211	−0.309
	(−0.97)	(1.06)	(−1.35)
L.*Close*	−0.175	−0.025	−0.028
	(−0.87)	(−0.45)	(−0.49)
Industry-Fixed Effect	Yes	Yes	Yes
Year-Fixed Effect	Yes	Yes	Yes
Observations	4476	1977	2011
R-squared	0.002	0.009	0.026

This table presents the regressions of a one-year lag of the *Female_CEO* variable on the investment efficiency variable, *Inv_Eff*. The firm-level controls are *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close.* The results are from the regressions with industry- and year-fixed effects. The values of the t-statistics in parentheses are from the robust standard errors clustered at the firm level. Model (1) includes all samples of Vietnamese firms, while Models (2) and (3) report the results for the Northern and Southern samples, respectively.

3.4. Endogeneity tests

Our female CEO dummy variable is unlikely to occur randomly. If our investment efficiency variable and the female CEO dummy variable are jointly determined by other unobservable firm and country characteristics, our regression results would be subject to

omitted variable bias (Gan, 2019; Lai et al., 2021). This situation can lead to a strong correlation between our explanatory variable and the error term. Therefore, in this section, we adopt two approaches to alleviate this endogeneity concern.

3.4.1. Entropy balancing approach

To address the endogeneity concern, we first employ an entropy-balancing approach to analyze covariate balance using a binary treatment (Hainmueller, 2012). Unlike the matching and propensity score methods, the entropy balancing approach does not discard the observations that fail to match. Instead, it uses a reweighting scheme to obtain a high degree of covariate balance without losing any observations.

The regression results after entropy balancing are displayed in Table 5. Model (1) shows the results for the whole sample, while Model (2) presents the results for the Northern companies. These findings show that the coefficient of *Female_CEO* is positive and statistically significant, consistent with our main findings. In Model (3), *Female_CEO* also displays a positive and statistically significant coefficient for the Southern region, but it is statistically different from that of Model (2) .[6] This further implies that female CEOs in the North tend to engage in risky investing behavior.

3.4.2. Instrument variable analysis

We next conduct an instrumental variable approach based on two separate instruments to further address endogeneity concerns. First, we consider the provincial Gender Inequality Index (GII) of Vietnam. As this is only available for 2019, we cut our sample from 2019 to 2021. We create a variable, *Gender_Equality*, by taking the log of the inverse of the collected GII. We also use the dummy variable *Female_President* indicating whether a firm has a female president in a given year. If a woman is leading a company, it is more likely to have a female CEO due to a trickle-down effect, suggesting that female managers tend to hire female employees due to their social similarities (Ibarra, 1992; McPherson et al., 2001).

Model (1) of Table 6 shows the first-stage regression results. Only *Gender_Equality* displays a positive and statistically significant coefficient with *Female_CEO*, while *Female_President* has a positive coefficient without statistical significance. With the predicted values of *Female_CEO* and *Female_CEO_hat*, we find a statistically strong result for the Northern sample in Model (2), while the coefficient for the Southern sample is statistically insignificant. Overall, the analysis based on the instrumental variable approach corroborates our baseline findings and provides supporting evidence that female CEOs in the North are more likely to engage in risky behavior.[7]

3.5. Regression with bootstrapping

While our sample size fits well in the context of Vietnam, the findings may still be subject to a slight sample bias. Therefore, bootstrapping regressions are also done to generalize the main findings by resampling our dataset to create many simulated samples. We used 1000 replications for each regression. In Model (1), *Female_CEO* displays a positive and statistically significant coefficient with the investment efficiency variable. Model (2) shows the results for the Northern sample, and the coefficient for Female_CEO is also positive and statistically strong, while it is insignificant for the Southern sample in Model (3). These results further support our main findings that female CEOs in northern companies tend to engage in risky behavior.[8]

4. Additional analysis

4.1. Risky firms

An interaction term between the *Female_CEO* variable and *Volatility,* a control variable representing the annual standard deviation of monthly stock returns, serves to investigate whether Northern Vietnamese female CEOs exhibit risk propensity due to fewer gender stereotypes. The interaction term only has a positive and statistically significant coefficient for the Northern sample in Model (2) of Table 5.[9] This supports our main finding that a lack of gender stereotype threat influences female CEOs' risky behaviors and overinvestment.

4.2. During COVID-19

Furthermore, we check if Northern Vietnamese female CEOs engage in riskier behavior than male CEOs during unstable times like the COVID-19 pandemic. The Covid variable is a dummy variable that equals 1 if the year is 2020 or 2021 (or both) and 0 otherwise. Again, the interaction term of *Covid* and *Female_CEO* is statistically significant only for the Northern sample in Model (2) of Table 6, indicating that Vietnamese CEOs take riskier actions than male CEOs, even during unstable times.[10] This result further supports our baseline findings (Tables 7–9).

[6] The coefficient difference test of *Female_CEO* between Models (2) and (3) for *Female_CEO_hat* is F-value (1, 791) = 3.15, p-value=0.0761

[7] The coefficient difference test of *Female_CEO* between Models (2) and (3) for *Female_CEO_hat* is F-value (1,791)=4.32, p-value = 0.038

[8] The coefficient difference test of Female_CEO between Models (2) and (3) for Female_CEO_hat is F(1, 791) = 5.75 p-value (0.0165)

[9] The coefficient difference test of interaction terms between Models (2) and (3) for Female_CEO_hat is F-value (1, 791) = 15.01, p-value=0.0001

[10] The coefficient difference test of interaction terms between Models (2) and (3) for Female_CEO_hat is F-value (1, 791) = 3.07, p-value=0.0799

Table 5
Entropy balancing approach.

Variables	(1) *Inv_Eff*	(2) *Inv_Eff*	(3) *Inv_Eff*
Female_CEO	0.101***	0.293***	0.075**
	(3.33)	(7.21)	(2.22)
Size	0.011	0.021**	0.006
	(0.95)	(2.06)	(0.61)
BTM	−0.017**	−0.011*	−0.023
	(−2.53)	(−1.73)	(−1.22)
ROE	−0.376	−0.334	0.196
	(−0.75)	(−0.91)	(1.35)
Leverage	0.471***	0.743***	0.170
	(3.31)	(3.74)	(1.14)
Cash	0.221	−0.030	0.073
	(1.57)	(−0.23)	(0.50)
Invop	0.138***	0.021	0.169***
	(2.73)	(1.26)	(2.81)
Volatility	0.534**	0.933*	−0.160
	(2.23)	(1.79)	(−0.75)
Close	−0.031	−0.218*	−0.068
	(−0.74)	(−1.86)	(−1.14)
Industry-Fixed Effect	Yes	Yes	Yes
Year-Fixed Effect	Yes	Yes	Yes
Observations	5240	2317	2350
R-squared	0.061	0.150	0.043

This table presents the regressions of the *Female_CEO* variable on the investment efficiency variable, *Inv_Eff*, using entropy balancing. The firm-level controls are *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close.* The results are from the regressions with industry- and year-fixed effects. The values of the t-statistics in parentheses are from robust standard errors clustered at the firm level. Model (1) includes all samples of Vietnamese firms, while Models (2) and (3) report results for the Northern and Southern samples, respectively.

Table 6
Instrumental variable approach.

Variables	(1) *Female_CEO*	(2) *Inv_Eff*	(3) *Inv_Eff*
Gender_Equality	**0.114****		
	(1.99)		
Female_President	**0.062**		
	(1.59)		
Female_CEO_hat		**4.445****	**−0.747**
		(1.98)	**(−0.69)**
Size	−0.003	0.045***	0.034
	(−0.62)	(2.67)	(1.25)
BTM	0.002	−0.013	0.035
	(0.34)	(−1.11)	(1.08)
ROE	0.003	−0.009	−0.006
	(1.59)	(−0.88)	(−0.50)
Leverage	0.048	−0.063	−0.455
	(1.02)	(−0.25)	(−1.29)
Cash	−0.027	0.105	0.124
	(−0.74)	(0.35)	(0.47)
Invop	−0.000	0.009	0.033***
	(−0.28)	(0.60)	(6.21)
Volatility	0.041	0.093	−0.138
	(0.54)	(0.26)	(−0.30)
Close	−0.002	−0.020	0.069
	(−0.13)	(−0.19)	(0.57)
Industry-Fixed Effect	Yes	Yes	Yes
Year-Fixed Effect	Yes	Yes	Yes
Observations	1861	992	853
R-squared	0.030	0.037	0.030

This table presents the regressions of a one-year lag of the *Female_CEO* variable on the investment efficiency variable, *Inv_Eff*. The firm-level controls are *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close.* The results are from the regressions with industry- and year-fixed effects. The values of the t-statistics in parentheses are from the robust standard errors clustered at the firm level. Model (1) shows first-stage regression, while Models (2) and (3) report the second-stage results for the Northern and Southern samples, respectively.

Table 7
Regressions with bootstrapping.

Variables	(1) *Inv_Eff*	(2) *Inv_Eff*	(3) *Inv_Eff*
Female_CEO	**0.073***	**0.283*****	**0.029**
	(1.65)	**(2.85)**	**(0.65)**
Size	0.011	0.024***	0.009
	(1.52)	(2.68)	(0.89)
BTM	−0.012	−0.002	−0.015
	(−1.49)	(−0.37)	(−1.04)
ROE	0.014	0.005	0.023
	(0.91)	(0.27)	(0.35)
Leverage	0.031	0.059	−0.040
	(0.42)	(0.59)	(−0.37)
Cash	−0.033	−0.150	0.051
	(−0.37)	(−1.04)	(0.51)
Invop	0.026	0.004	0.079***
	(1.18)	(0.43)	(3.22)
Volatility	0.205	0.508	−0.066
	(0.95)	(1.44)	(−0.36)
Close	−0.021	−0.007	−0.058
	(−0.55)	(−0.13)	(−1.21)
Observations	5783	2571	2590
R-squared	0.018	0.010	0.084

This table presents the regressions of the *Female_CEO* variable on the investment efficiency variable *Inv_Eff* with bootstrapping. The firm-level controls are *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close.* The results are from the regressions with industry- and year-fixed effects. The values of the t-statistics in parentheses are from the robust standard errors clustered at the firm level. Model (1) includes all samples of Vietnamese firms, while Models (2) and (3) report the results for the Northern and Southern samples, respectively.

Table 8
Risky firms.

Variables	(1) *Inv_Eff*	(2) *Inv_Eff*	(3) *Inv_Eff*
*Female_CEO * Volatility*	0.951	2.902***	−0.331
	(1.40)	(4.14)	(−0.73)
Female_CEO	−0.004	−0.091	0.129
	(−0.05)	(−1.21)	(1.61)
Size	0.027***	0.040***	0.022**
	(3.73)	(4.00)	(2.05)
BTM	−0.013***	−0.008	−0.014***
	(−6.06)	(−1.19)	(−11.05)
ROE	0.013	0.007	0.018
	(1.59)	(0.97)	(1.18)
Leverage	0.045	0.061	−0.014
	(0.53)	(0.60)	(−0.10)
Cash	0.072	−0.013	0.107
	(0.79)	(−0.11)	(0.96)
Invop	0.026	0.003	0.078***
	(1.32)	(1.13)	(3.70)
Volatility	0.290*	0.271	0.084
	(1.92)	(1.16)	(0.41)
Close	−0.011	−0.023	−0.032
	(−0.28)	(−0.44)	(−0.64)
Industry-Fixed Effect	Yes	Yes	Yes
Year-Fixed Effect	Yes	Yes	Yes
Observations	5240	2317	2350
R-squared	0.039	0.035	0.115

This table presents the regressions of a one-year lag of the *Female_CEO* variable on the investment efficiency variable, *Inv_Eff*. The firm-level controls are *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close.* The results are from the regressions with industry- and year-fixed effects. The values of the t-statistics in parentheses are from the robust standard errors clustered at the firm level. Model (1) includes all samples of Vietnamese firms, while Models (2) and (3) report the results for the Northern and Southern samples, respectively.

Table 9
Risky times.

Variables	(1) *Inv_Eff*	(2) *Inv_Eff*	(3) *Inv_Eff*
*Female_CEO * Covid*	0.258*	0.708**	0.159
	(1.90)	(2.50)	(1.19)
Female_CEO	0.023	0.045	0.028
	(0.92)	(1.17)	(0.83)
Size	0.027***	0.040***	0.022**
	(3.73)	(4.01)	(2.06)
BTM	−0.013***	−0.007	−0.014***
	(−5.95)	(−1.10)	(−11.08)
ROE	0.013	0.007	0.017
	(1.57)	(0.96)	(1.16)
Leverage	0.042	0.054	−0.015
	(0.50)	(0.53)	(−0.11)
Cash	0.071	−0.010	0.110
	(0.78)	(−0.08)	(0.98)
Invop	0.026	0.003	0.078***
	(1.32)	(1.12)	(3.70)
Volatility	0.322**	0.320	0.077
	(2.16)	(1.38)	(0.39)
Close	−0.010	−0.019	−0.032
	(−0.25)	(−0.36)	(−0.63)
Industry-Fixed Effect	Yes	Yes	Yes
Year-Fixed Effect	Yes	Yes	Yes
Observations	5240	2317	2350
R-squared	0.040	0.037	0.115

This table presents the regressions of the *Female_CEO* variable and the interaction term of *Female_CEO* and *Covid* on the investment efficiency variable, *Inv_Eff. Covid* equals 1 for 2020 and 2021 and "0" otherwise. The firm-level controls are *Size, BTM, ROE, Leverage, Cash, Invop, Volatility,* and *Close.* Results are from the regressions with industry and year-fixed effects. The values of the t-statistics in parentheses are from the robust standard errors clustered at the firm level. Model (1) includes all samples of Vietnamese firms, while Models (2) and (3) report the results for the Northern and Southern samples, respectively.

5. Conclusion

This paper investigates the impact of gender stereotype threats on female CEOs' risk-taking behavior. Using samples from Vietnamese firms in the Northern and Southern regions, we find that female CEOs in the North, where there is a weaker gender stereotype threat, overinvest. Such behavior persists even when the firm's risk is high and during times of uncertainty, like the COVID-19 pandemic. Thus, environmental factors play a significant role in female leaders' success, indicating that biological differences in risk-taking may not affect their behaviors as much as gender stereotype threats and other environmental factors. Our study contributes to the literature on female CEOs and the importance of considering environmental factors when examining female leaders.

Declaration of Competing Interest

There are no conflicts of interest to declare.

Data availability

The authors do not have permission to share data.

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Appendix A

City	Division	City	Division
BA RIA	South	LONG AN	South
BA RIA - VUNG TAU	South	LONG XUYEN	South
BAC GIANG	North	MY THO	South

(*continued on next page*)

(*continued*)

City	Division	City	Division
BAC KAN	North	NAM DINH	North
BAC LIEU	South	NGHE AN	
BAC NINH	North	NHA TRANG	
BAO LOC	South	NINH BINH	North
BEN TRE	South	PHAN THIET	South
BIEN HOA	South	PHU LY	North
BINH DUONG	South	PHU THO	North
BINH PHUOC	South	PHUC YEN	North
BINH THUAN	South	PLEIKU	
BUON MA THUOT	South	QUANG BINH	
CA MAU	South	QUANG NAM	
CAM PHA	North	QUANG NGAI	
CAM RANH	South	QUANG NINH	North
CAN THO	South	QUI NHON	
CAO BANG	North	RACH GIA	South
CAO LANH	South	SA DEC	South
DA LAT		SOC TRANG	South
DA NANG		SON LA	North
DAK NONG	South	SONG CONG	North
DI AN	South	TAM DIEP	North
DONG HOI		TAM KI	
DONG NAI	South	TAN AN	South
DONG THAP	South	TAY NINH	South
GIA LAI		THAI BINH	North
HA GIANG	North	THAI NGUYEN	North
HA LONG	North	THANH HOA	North
HA NAM	South	THU DAU MOT	South
HA TINH		THUA THIEN - HUE	
HAI DUONG	North	THUAN AN	South
HAIPHONG	North	TIEN GIANG	South
HANOI	North	TRA VINH	South
HAU GIANG	South	TUY HOA	
HO CHI MINH	South	UONG BI	North
HOA BINH	North	VI THANH	South
HOI AN		VIET TRI	North
HUE		VINH	North
HUNG YEN	North	VINH LONG	South
KHANH HOA		VINH PHUC	North
KIEN GIANG	South	VINH YEN	North
KON TUM		VUNG TAU	South
LANG SON	North	YEN BAI	North
LAO CAI	North		

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