

# **Is Gender in the Pocket of Investors?**

## **Identifying Gender Bias Towards CEOs with a Lab Experiment**

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### Abstract

We build a trading experiment to causally identify gender bias towards newly appointed CEOs. We distinguish between gender stereotypes and in-group favoritism / out-group discrimination as theoretical sources of gender bias. When a female CEO is appointed, we find that female participants buy stocks, while male participants sell stocks. The opposite holds when a male CEO is appointed. For male traders, our results are consistent with both stereotypes and in-group bias. For female traders, we are able to identify evidence of in-group favoritism towards female CEOs that dominates the potential effect of their gender stereotypes towards female CEOs. These gender biases combined with the lack of gender diversity in the stock market can explain both the negative stock market reaction to female CEO appointments and the underrepresentation of female CEOs. These results suggest that the stock market is ‘gendered’ and constitutes a glass ceiling barrier for female reaching CEO positions.

**Keywords:** CEO, in-group favoritism, out-group discrimination, gender bias, gender diversity, gender stereotypes, glass ceiling, stock market.

**JEL:** J16, M14.

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# 1 Introduction

That women are a numerical minority in chief executive officer (CEO) positions in the major world economies is a well-known phenomenon. For example, in the European Union, women represent only 7.5% of the largest publicly listed companies' CEOs (EIGE, 2020), despite substantial resources being invested in fighting gender inequality as part of the EU gender equality strategy. What explains the persisting underrepresentation of women at the top?

Objective differences in qualifications and competencies between men and women are becoming less relevant, as women have recently reversed the gender gap in educational attainment and have significantly narrowed the gap in years of professional experience (Blau and Kahn, 2017). Furthermore, these factors may be less relevant for female CEOs, which represent a select pool (Adams and Ragunathan, 2017). Despite these, women face barriers to their advancement in corporate hierarchies, also known as the glass ceiling. Because these barriers are not related to female candidates' qualifications or competence, they are costly to corporations and society at large and important to understand. At the corporate level, CEO successions matter and have received the attention of research in strategic management since they are often seen as a signal of the firm's future path (Zajac, 1990).

The glass ceiling has been prominently documented within organizations. Studies have shown evidence of a gender bias among board members when involved in the CEO selection process (Matsa and Miller, 2011). Theoretical explanations for such bias include discrimination against women (Becker, 1957) and gender stereotypes involving nonconscious heuristics, such as the 'think manager-think male' (Schein, 1973). Contextual factors also play a role in reinforcing or mitigating such biases. Regarding reinforcing factors, biases against female CEOs are more prevalent in stereotypically male industries (Glass and Cook, 2016). In contrast, women CEOs are perceived to be more suitable in industries with a larger share of female workers. Regarding mitigating factors, Ryan and Haslam (2005) argue that poorly performing firms are more likely to appoint women (a phenomenon coined the 'glass cliff effect').

In this paper, we study the reaction of stock market investors to the appointment of female and male CEOs. Investors are an important external audience whose reaction may constitute a demand-side barrier that is external to the firm and that indirectly poses a constraint on firm's management choices. Because investors can sell their stocks, they can vote with their feet to express discontent with the appointed CEO. This trading activity may, therefore, influence a firm's CEO appointment decision backwardly: the firm may partly choose its CEO to avoid future

downward pressure on its market valuation. Such concerns are not merely hypothetical as evidence shows that stock markets in the US react more negatively to the appointment of a female CEO than to that of a male CEO (Lee and James, 2007). This result has also been documented in China, particularly in male-to-female CEO transitions (Zhang and Qu, 2016) and for international firms in Germany (Schmid and Dauth, 2014).

The fact that stock prices fall significantly when a company announces the appointment of a female CEO contrasts with evidence showing that in the long term, companies led by female CEOs do not underperform those led by male CEOs (Wolfers, 2006). In fact, they may even overperform as shown by the meta-analysis of Jeong and Harrison (2017), and have a higher survival rate (Faccio, Marchica and Mura, 2016). Therefore, the stock market short term reaction may indirectly influence the corporate strategy vis-à-vis staffing choices at the top and as a consequence the firm's long-term performance, orientation and survival.

Despite this potential significance, the study of the stock market response to female CEO appointments as a process that underlies discrimination has been understudied in the gender and leadership scholarship. A possible reason for this is that this process takes place outside organizations. Furthermore, interpreting why stock prices fall significantly when a company announces the appointment of a female CEO is not an easy task. On the corporate side, the pure effect of gender is difficult to disentangle from the other characteristics of the appointed CEO and the conditions of the appointment. Identifying the causal effect of gender involves controlling for appointment conditions (such as the existence of a nomination committee and the involvement of the departing CEO) and contextual factors (such as the past performance of the firm). On the stock market side, evidence is often based on aggregate stock market data which cannot tell us how any particular investor assesses any particular CEO, making it harder to reveal and explain the presence and sources of a gender bias among investors. Understanding the sources of a gender bias may be particularly relevant considering the fact that gender diversity among investors is rather low. Only 16% of holders of the chartered financial analyst (CFA), one of the professional qualifications to work in the financial industry, are women (Mattia, 2018), and only 10% of US equity funds are managed by women (Niessen-Ruenzi and Ruenzi, 2019).

Could a gender bias among investors play a role in explaining the negative stock market reaction to female CEO announcements and, if so, what is the source of such a bias? This paper answers this question by studying the presence of a gender bias in investor's reaction to the CEO appointment and investigating its source drawing from two distinct theoretical explanations: gender stereotypes and in-group bias (in-group favoritism and out-group discrimination). Heilman

(2012) defines gender stereotypes as generalizations about men and women applied to individuals because they are men and women. Tajfel (1982) defines in-group favoritism as a tendency to treat favorably individuals of one's own group, leading to homosocial reproduction (Kanter, 1977). We argue that gender bias can explain the reaction of stock market investors to the appointment of female CEOs. We make hypotheses regarding 1) the role of negative gender stereotypes about female leadership abilities and 2) the role of in-group biases such as favoritism toward in-group members and discrimination toward out-group members. Distinguishing between the two sources of gender bias is important for theory. At the theoretical level, our work goes beyond the existing paradigm which posits that the negative stereotypes about females in positions traditionally occupied by men are held both by men and women in the workplace (Heilman, 2012). To do so, we argue that concurrently to gender stereotypes, investors decision-making may exhibit in-group biases. We provide ways to tease out the two sources of bias from observed trading choices by considering the gender of participants.

We test our hypotheses through a lab experiment. The experiment is based on a trading simulation platform that mimics the environment of practitioners in financial markets, which enables us to contextualize the trading decisions of participants. Critically, the experiment is designed to study the market reaction to the appointment of the new CEO at the level of individual participants. Our experimental approach enables us to identify the pure effect of the gender of the CEO on individual trading activity, providing causal evidence of a gender bias. Furthermore, it also allows us to precisely map the gender of the participant to his or her trading activity, which is key to empirically distinguish between gender stereotypes and in-group bias as a source of gender bias in the trading reaction.

We find evidence consistent with the presence of a gender bias rooted in in-group favoritism among female investors. That is, the preference towards the gender of the CEO is moderated by participants' gender. Therefore, the gender of investors matters. Given the lack of gender diversity among stock market participants, our hypothesis provides an explanation for the negative stock market reaction to female CEO appointments and potentially for the rarity of women in corporate leadership positions.

We make three contributions to several strands of literature. First, an important contribution of our research to the literature on gender and leadership is to provide a rigorous causal identification of the existence and nature of gender biases towards female and male CEOs in an investment context. Extant research has focused on identifying gender stereotypes among internal audiences. We argue that stock market investors are an important external audience and find that cold-

blooded and financially motivated decision-making in a trading environment are also prone to gender biases. Second, a related contribution is to shed new light regarding the debate between supply-side and demand-side explanations in the glass ceiling literature. In particular, in our context, we identify the role of demand-side factors (negative gender biases towards female CEOs) among external audiences (stock market). We are able to do so, contrary to existing empirical work, because our experiment identifies the pure role of demand factors, as traders have no information regarding the qualifications of the female and male CEOs in the experiment. That is, we show that demand-side factors play an important role in explaining the negative bias towards female CEOs. This does not imply that supply factors are unimportant but rather that demand factors are to be considered on their own. Third, we shed light on the nature of gender biases towards female and male CEOs, contributing to the literature on gender stereotypes and in-group biases. In particular, one of the puzzling results of the literature on gender stereotypes is that both female and male evaluators hold similar stereotypes about gender across a variety of settings. At the same time, research about in-group biases suggests that generic norms of group affiliation are deeply embedded in our social structure and easily triggered in situations involving judgment of others through a group lens. Our work contributes to both literature by providing a unified approach where both types of biases can be concurrent and shows how to quantitatively disentangle the effect of both gender stereotypes and in-group biases. We show that gender stereotypes and in-group biases can either reinforce each other or counter each other. Furthermore, whether this is the case depends on the group affiliation.

The remainder of this paper proceeds as follows. Section 2 discusses our theory, Section 3 lays out our methods, Section 4 presents the data and measures, Section 5 displays our results, and Section 6 uses our results to provide further analysis. Finally, Section 7 concludes by discussing policy implications and avenues for future work.

## **2 Theory**

In this section, we present our theoretical development, our hypotheses and their operationalization. We actively engage with the existing literature about leadership and gender stereotypes and in-group bias.

### **2.1 Leadership and gender stereotypes**

The rarity of females in corporate leadership positions has been attributed to both supply side and demand side factors in the job market for CEOs. On the supply-side, objective differences have been found in CEOs' career trajectories (e.g., Singh and Vinnicombe, 2003), demographic factors

including age and family status (e.g., Harlan and Weiss, 1982) and differences in leadership abilities, style (Eagly, Karau and Makhijani, 1995) and behavioral traits that correlate with gender. For instance, gender differences have been documented in the degree of risk aversion (Crozon and Gneezy, 2009), even among CEOs (Faccio et al., 2016), although these differences have recently been called into question by (Fillipin and Crosetto, 2016). Research also finds gender differences in overconfidence and optimism (Huang and Kisgen, 2013), taste for competition (Niederle and Vesterlund, 2011) and bargaining styles (Card, Cardoso and Kline, 2016). These gender differences could constitute the basis for statistical discrimination (Phelps, 1972). According to this theory, in a context of asymmetric information between recruiters and job market candidates, recruiters may infer individual productivity based on statistical information about the group (in this case, gender) to which an individual belongs.

On the demand-side, women have been shown to face invisible barriers in accessing leadership positions independently of their objective qualifications. Some of these barriers are internal to the firm and relate to its corporate governance, which has been shown to influence CEO appointment decisions. For example, the result of such decisions may directly depend on whether the board of directors is independent vis-à-vis the current CEO and whether a hiring board is put in place (Shivdasani and Yermack, 1999). Other internal factors are related to firm performance and its sector. Regarding firm performance, Ryan and Haslam (2005) show that negative company performance in the months leading to the CEO transition is predictive of the appointment of female CEOs. Regarding the firm sector, Harrigan (1981) shows that female executives are more likely to be appointed by labor-intensive, service-oriented firms catering to female consumers, whereas female executives are less likely to be appointed in capital-intensive sectors, including manufacturing, or in sectors with a male-dominated workforce, such as mining (Davidson and Cooper, 1992; Goodman et al., 2003).

These internal barriers to women's advancement are rooted in gender stereotypes which are generalizations about men or women that are applied to individuals because they are men or women. Stereotypes have been documented in a variety of settings. Becker (1957) theoretically studies discrimination in the labor market based on the assumption that decision makers exhibit taste-based discrimination as a result of a preference against interacting with members of certain groups, such as women. Stereotypes are often applied to individuals belonging to minority groups, a concept known as entitativity, and are defined based on the stereotyped group characteristics rather than individual singularities, a phenomenon documented by Dixon-Fowler et al. (2013).

Less studied are the glass ceiling barriers that are external to the firm. These barriers include the

role of the media and the behavior of stock market investors for publicly traded companies. Considering the role of the media, Lee and James (2007) show that the media tends to portray men and women CEOs differently, reinforcing existing gender stereotypes. Similarly, Dixon-Fowler et al. (2013) show that female CEOs are perceived as belonging to minority groups defined by stereotypical characteristics rather than by their individual singularities.

Considering the behavior of stock market investors is important because their reactions can influence corporate decision making and exert a “feedback loop” on the firm (Dow, Goldstein, Guembel, 2017).<sup>3</sup> In the case of CEOs, investors can influence firms’ CEO appointments by voting with their feet and selling stocks when a CEO they do not like is appointed. Indeed, empirical work by Lee and James (2007) and Zhang and Qu (2016) documents, in the US and Chinese contexts, respectively, that stock markets tend to react more negatively to the appointment of a female CEO than to that of a male CEO. Because the expected financial benefits and costs from changes in leadership are borne by investors, their trading decisions can exert a subtle and invisible influence on firms’ CEO choices. Fluctuations in the stock price following the appointment of male and female CEOs may be anticipated by the firm and affect the decision to appoint a female or a male CEO. This negative feedback effect may constitute an external barrier to women’s advancement. However, external barriers originating in the stock market remain poorly understood partly due to methodological challenges in identifying a causal mechanism.

We argue that stock market activity sets in motion an evaluative process in the form of buying or selling stocks. Existing research, based on archival data, uses changes in stock price as a “barometer for how investors assess the decision’s potential effect on a corporation’s short- and long-term economic viability” (Cook and Glass, 2011, page 503). As developed next, we argue that this assessment is potentially gender biased and that it is rooted in descriptive gender stereotypes according to which women are not fit to occupy traditionally male positions such as that of CEO.

A participant buying stocks of the company reveals that he or she perceives the event as good news, while a participant selling stocks reveals that he or she perceives the event as bad news. These decisions can be the result of rationally updated beliefs about the impact of the appointed CEO on the firm’s future cash flows (Fama, 1970) and more generally on firm’s performance. However, trading activity may also reflect behavioral factors including psychological processes

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<sup>3</sup> The feedback effect from financial markets to firms is also discussed in the theory of reflexivity developed by Soros (1988).

that result in the use of decision-making heuristics rather than rational and deliberate decision making. Decision-making heuristics are often based on a combination of expertise and stereotypes and are automatically triggered in a non-conscious manner (Kahneman and Tversky, 2000). Decision-making heuristics and stereotypes are often triggered in situations of uncertainty leading investors to unconsciously replace the answer to the rational question “Does the appointed CEO create value?” with the answer to a simpler question “Do I like the appointed CEO?” or “Is the appointed CEO fit to the position?” according to the ‘Lack of fit’ model (Heilman, 1983).

In the job market for CEOs, Schein (1973) proposes the existence of an automatic ‘think manager-think male’ stereotype that may explain the lack of female promotion to CEO roles. Gender stereotypes are, according to the ‘Lack of fit model’ (Heilman, 1983), prone to create negative expectations about performance of women because CEO positions and leadership roles more broadly are seen as male (Koenig, Eagly, Mitchell and Ristikari, 2011). Powell, Butterfield and Parent (2002) test the hypothesis that performing managers are described as having masculine traits of character and leadership style. As they point out, the formation and use of stereotypes reveal both a cognitive shortcut (to minimize information processing costs). By surveying student populations in three different decades (1979, 1989 and 1999), they study the persistence or change of those stereotypes. Although they find some evidence of change in stereotypes due to the increase in female presence in managerial positions throughout the period, the masculine view of managers persists.

According to the ‘Lack of fit model’, we posit the following hypothesis:

**Hypothesis 1: Stock market participants hold gender stereotypes towards CEOs characterized by negative performance expectations towards female CEOs and positive performance expectations towards male CEOs.**

Hypothesis 1 makes no difference according to the gender of individual stock market participants. This is based on extant research that argues that both female and male evaluators hold gender stereotypes. For example, in the financial sector, Olsen and Cox (2001) find that both female and male professionally trained investors hold gendered stereotypes about other investors’ risk taking. One reason explaining this phenomenon is that, as Hentschel, Heilman and Peus (2013) research suggests, women self-evaluate themselves, and therefore other women as well, according to those same gender stereotypes. Another explanation is that women evaluating other women compete for such positions (Parks-Stamm, Heilman and Hearn, 2008). The fact that men and women hold similar gender stereotypes is puzzling as stressed by Heilman (2012).



As Tajfel (1970) argues that stereotypes develop with deeply rooted notions of “we” versus “they”, forming the basis for how individuals are expected to judge and behave vis-à-vis other members of society. Interestingly, as Tajfel (1970) experimental evidence shows, social learning and conformity trigger a generic norm of in-group bias that is independent of the context and “extraordinarily easy to trigger off”. Because gender is a key organizing pillar in the social construction of reality, gender biases may therefore reflect not only the gender of the evaluatees but also the group affiliation of the evaluator. In other words, gender biases may result from intergroup categorization and reflect favoritism towards an individual in-group and discrimination towards an individual out-group. To the extent that investors’ decision-making is influenced by one’s psychology and sociocultural milieu, gender biases may be cut across gender lines. We develop the implications of this possibility in the next section.

## **2.2 In-group bias**

Research studying the role of gender biases in preventing the career progression of female managers and their appointment to top leadership positions has also emphasized the role of in-group biases. For example, decision makers in hiring committees and boards have been shown to exhibit in-group favoritism and reserve leadership positions for in-group members (Powell, Butterfield and Parent, 2002, Matsa and Miller, 2011). In-group bias has also been documented among financial analysts that recommend stocks (Janati et al., 2020), venture capitalists that fund entrepreneurs in the primary market in various forms (Greenberg and Mollick, 2017, Hebert, 2019), firms that bargain deals in mergers and acquisitions (Levi, Li and Zhang, 2014).

In-group bias is closely related to the concept of homophily (McPherson, Smith-Lovin and Cook, 2001), which refers to a sociological concept according to which “like is attracted to like” (Greenberg and Mollick, 2017). Its manifestation at the structural level is known as “induced homophily”, as networks are more likely to be composed of individuals of similar type or social category. These networks and affiliations influence individual interactions with members of the in-group, impacting opportunities of in-group and out-group members (Currarini and Mengel, 2016). Interestingly, gender is a prominent basis for homophily (Ibarra, 1992; Kleinbaum, Stuart and Jushman 2013). A consequence of homophily is that the prevalence of men in decision-making and leadership positions can constitute a structural hurdle for women aiming to access top leadership roles (Pfeffer and Davis-Blake, 1989). Similarly, research on the impact of gender diversity within corporate boards appears to suggest that adding women to the board eases the hurdles posed by men who tend to favor their in-group members and reproduce social structures (Matsa and Miller, 2011). While in-group favoritism implies that male-dominated boards are more

likely to appoint male CEOs, more diverse boards can tilt the favor towards female board members and consequently female CEOs (Ely, 1995).

To date, in-group bias has been used as a lens to describe the preferences of decision makers internal to the firm, leading to homosocial reproduction at the top. To the best of our knowledge, no research has studied the role of in-group bias to explain stock market investors evaluation of female and male CEOs. In-group bias among stock market investors is likely to operate both at the structural level (shaping the networks of investors) and at the interpersonal level (influencing their choices). At the interpersonal level, individuals may be attracted by individuals that resemble them, a phenomenon defined as “choice homophily”. Greenberg and Mollick (2017) further distinguish between interpersonal choice homophily, based on similarity, and activist choice homophily, which is based on the perception of shared barriers. In our context, female traders may support women CEO because of shared values and similarities but also because of a conscience of shared structural barriers to access such positions, particularly in industries where they are under-represented (Greenberg and Mollick, 2017). Consistent with these different sources for in-group biases based on gender homophily, we argue that traders will exhibit in-group favoritism towards CEOs of their own gender and out-group discrimination towards CEOs of the opposite gender. We formulate our second hypothesis as follows:

**Hypothesis 2: Stock market participants exhibit in-group bias towards CEOs characterized by in-group favoritism towards a CEO of their own gender and out-group discrimination towards a CEO of the opposite gender.**

Hypothesis 2 argues that stock market participants’ assessment of CEOs depends on their own gender in a way consistent with in-group favoritism and out-group discrimination. While in-group biases have not been previously analyzed to describe stock market activity, they have been extensively used to describe the behavior of decision-makers within the corporate world. Our paper contributes to enrich the big picture about gender bias against female CEOs by analyzing the understudied role of stock market investors.

### **2.3 Operationalization**

Based on our theoretical construct (participants’ preference towards the appointed CEO’s gender), our hypotheses argue that preferences towards the gender of the CEO exhibit gender stereotypes and in-group bias; that is, they may depend on the individual’s own gender. Operationalizing and possibly distinguishing between our two hypotheses require clearly identifying the two gender dimensions of our hypothesis: the gender of the CEO and the gender of the market participants.

Regarding the CEO, identifying a pure gender effect requires separating gender from other CEO characteristics that are known to be supply-side factors in the CEO job market. Regarding participants, we know the gender of each individual participant, which enables us to analyze individual trading reactions to the announcement of a female or male CEO as a function of the participant's gender. Formally, participant's gender is our moderating variable which can change the relationship between the trading reaction of participants to the CEO appointment (our dependent variable) and the gender of the appointed CEO (our manipulated variable).

Hypothesis 1 and Hypothesis 2 predict the same trading behavior for male stock market participants. In particular, they predict that male traders buy stocks when a male CEO is appointed and sell stocks when a female CEO is appointed. Therefore, observing male traders' behavior does not allow us to distinguish the role of these two theoretical sources of gender bias. On the contrary, Hypothesis 1 and Hypothesis 2 predict different trading behavior for female stock market participants. While Hypothesis 1 predicts that female participants hold gender stereotypes against female CEOs, and therefore that they sell stocks when a female CEO is appointed, Hypothesis 2 predicts that female participants in-group favoritism leads them to buy stocks when a female CEO is appointed.

### **3 Methods**

In this section, we start by motivating our choice of methodology—a lab experiment—in relation to our theoretical development. We then discuss our experimental design and explain certain key choices. Next, we describe our choice of participants and the experimental setting in detail. We conclude the section by discussing internal and external validity issues.

#### **3.1 Motivation**

The main added value for using a lab experiment is in the ability to observe trading decisions at the individual level. The choice of a lab experiment also overcomes two main challenges of empirical studies: the paucity of real data and more critically the difficulty of making causal inferences. The paucity of data is due to the limited number of female CEOs, which makes it difficult to use archival data to empirically estimate investors' reaction to the appointment of female CEOs. In contrast, lab experiments can be designed to balance the proportion of male and female CEOs. Regarding causal inference, archival data makes it hard to study the pure effect of gender of the CEO because no two CEOs in the real world are identical except for their gender, and differences in objective and behavioral factors can blur identification. With an experimental approach, on the contrary, we can expose investors to CEOs whose gender is the only manipulated

variable. In the trading simulation, the only information provided is the name of the CEO, from which gender can be inferred. On the investors side, empirical analysis cannot separate the relative roles of biases from that of endowments, and available information in accounting for the trading reaction to the appointed CEO's gender. To address this second issue, our lab experiment relies on a trading simulation in which each participant is endowed with the same initial portfolio (composed of stocks and cash) and faces the same news flow regarding the company. This setting allows us to isolate the role of potential confounding factors other than those related to individual preferences. It is challenging to control for a firm's internal or external contextual factors that play a role in explaining the appointment and suitability of female CEOs. Indeed, using archival data renders causal inference challenging for two main reasons. First, the researcher may not observe all the relevant variables, which can be problematic because an omitted variable may affect both the stock market activity and the likelihood of appointing a female or male CEO. For example, according to the glass cliff hypothesis, firms performing poorly are more likely to appoint female CEOs. Because of their negative performance, such firms are also more likely, regardless of their CEO, to be shorted by traders. This may cause observers to conclude that there is a negative causal link between the two factors—the appointment of a female CEO and the stock market reaction—while none actually exists. Another concern is that firms may choose their CEO strategically, taking into account the expected market reaction using backward induction. Firms may also choose strategically when to release information to either maximize or minimize investors' and media attention on the news. A related but distinct informational issue includes the fact that some market participants may hold private information regarding the CEO appointment, making it difficult to determine exactly when investors learn and therefore react to the CEO appointment (Malatesta and Thompson, 1985). Finally, market participants' limited attention means that traders may not immediately react to the news (Hirshleifer and Teoh, 2003). In short, using archival data to study managerial changes is likely to suffer from omitted variable bias and reverse causality concerns. Therefore, randomized experiments are best suited to investigate the causal mechanisms behind many of the theories in the field of gender leadership and, more concretely, to testing our hypothesis.<sup>4</sup>

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<sup>4</sup> Experiments have previously been used to study gender-related topics such as the glass cliff phenomenon (Haslam and Ryan, 2008), the role of psychological mechanisms in explaining risk-taking decisions in financial markets (Eckel and Füllbrunn, 2015) and flows into investment funds (Niessen and Ruenzi, 2019).

### 3.2 Experimental design

While we describe the experiment in detail in the next section, we now discuss four key experimental design choices and their rationales: first, we adopt a between-subject design; second, we define our control and treatment groups; third, we conduct an experiment with mixed-gender participants; and fourth, we use a consequential experiment.

Applied to our setting, a between-subject design means that each participant in the experiment launches the simulation once and randomly faces, with equal probability, either the variant of the simulation where the firm appoints a male CEO or the variant where the firm appoints a female CEO. While both between-subject and within-subject design methods have their advantages and disadvantages (Charness, Gneezy and Kuhn, 2012), we made the choice to follow Greenwald (1976), who noted that when exposure to multiple experiments makes the individual sensitive to the variations between experiments, a between-subject approach should be chosen. Indeed, in a within-subject experiment, participants would have been confronted with the two variants, and therefore, by changing the gender of the CEO between the two consecutive variants, they would have been made aware (implicitly) of our variable of interest. This could potentially lead to a ‘demand effect’, which is a spurious effect reflecting the attempt of participants to behave in a way that satisfies their perception of the experimenter’s expectations.

The second choice involved the definition of the control and treatment groups. A question that we asked ourselves when developing the experiment was how to define what constitutes the control group relative to CEO gender. For the control group, we decided to use the simulation variant with an appointed male CEO because it corresponds to the baseline case that investors have in mind. This choice of benchmark is consistent with the statistics about the number of male/female CEOs observed in real firms; it is also in line with prevailing gender stereotypes about CEOs reflected in the think manager-think male heuristic. Furthermore, since the departing CEO is chosen to be male, the appointment of a male CEO does not lead to a gender change in the management of the firm. The control group faces the standard scenario in the business world that fits the gender stereotype of male occupying top management positions. In contrast, the appointment of a female CEO leads to a CEO transition involving a gender change and therefore constitutes our treatment. This is also representative of most CEO transitions frequently involving male-to-male CEO

changes and rarely involving male-to-female transitions.<sup>5</sup> Participants in our experiment are, therefore, randomly exposed either to the appointment of a male CEO (our control group) or to the appointment of a female CEO (our treatment group). Gender is the only dimension of the intervention in our experiment. There are no confounding factors as the two variants of the simulation differ only in the gender of the CEO.<sup>6</sup>

The third choice we made was to run a mixed-gender experiment (with female and male participants together). The reason for using a mixed-gender approach is that by mixing both female and male participants, we avoid a signaling effect about the relation of our research project to the gender of participants. Should we have chosen to run an all-male or all-female experiment, this could have created a demand effect by signaling to participants that their gender was important for their participation in our experiment and ultimately for our research question.

Our fourth design choice was to run *consequential* experiments. As Lonati et al. (2018) explain, it is important to build experiments where participants' behavior has real consequences in the form of incentives. This approach increases both motivation and attention from participants and decreases behavior that aims to conform to the expectations of the experimenter or to what is socially acceptable. In our experiment, therefore, we incentivize participants by granting them a grade bonus for their *finance* course as a function of their trading performance in the experiment. We decided to grant a grade bonus rather than monetary compensation because students' GPA (grade point average) in their first year is key for selection into prestigious exchange programs or highly demanded internships, involving real stakes for students.

### **3.3 Choice of participants**

We recruited participants on a voluntary basis among the students enrolled in the core *finance* course at a leading French business school. The sample of participants in our experiment represents 33% of the population of first-year students. The sample and the population present similar characteristics in terms of demographics (age and gender). In particular, the average age is the same (20 years old), and female representation in the sample (56%) is slightly above that in

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<sup>5</sup> For the control group, we did not choose a simulation in which no information was given about the gender of the CEO—a “neutral” simulation—because such a case does not correspond to a possible value for our manipulated variable (the CEO gender) and, more importantly, because it would not address our research question, which is to explain investors' reaction to the appointment of a female CEO in a world where they replace a male CEO.

<sup>6</sup> Our experimental design is similar in spirit to the experimental design in Adams et al. (2017) in the art market where buyers are unable to say whether a man or a woman makes an art piece unless they know the name of the artist. This implies that the discount on female art is due to the gender of the artist which is inferred from the name of the artist rather than to objective differences between the art made by men and women or to other information.

the population (52%). Regarding academic performance, the average grade in the finance course in the sample (11.21) is slightly above that in the population (10.34).

Relying on a sample of students has the advantage of avoiding biases that affect the selection of male and female investors (Eckel and Füllbrunn, 2015; Adams and Raganathan, 2017). Furthermore, because all students follow the same course track and have the same background in finance, confounding factors, such as field of study (or education) and experience, are eliminated.<sup>7</sup> The experiment was conducted in the school experimental lab, specifically designed for conducting experiments in a *controlled* environment. The experiment was presented to students as an opportunity to contribute to a research project studying how economic agents make financial decisions. Following common practice, the gender aspect of the research project was not revealed to the participants to avoid disclosing our research subject.

### 3.4 Experimental setting

The experiment is based on a trading simulation platform called SimTrade. In contrast to out-of-context experiments (such as lotteries used to measure preferences), this platform enables us to contextualize our variable of interest: CEO gender. The platform also increases the psychological realism of the experiment as it mimics the environment of practitioners in financial markets. At the launch of the simulation, participants are introduced to a simulation scenario that contextualizes the CEO appointment within a company named SunCar, a fictitious company described as designing, producing and selling electric vehicles. We chose an automotive company because it belongs to an industry that is perceived as a male industry according to gender stereotypes. The downside of contextualization is that our results may not generalize to other industries, an issue discussed in the next section, which could be addressed in future research with alternative scenarios that manipulate the industry.

The reason for the CEO appointment is sickness of the departing CEO. This choice is made to have an exogenous reason for the appointment of a new CEO. We named the departing CEO Jacques Dallara and chose the male gender for the departing CEO, in line with prevailing stereotypes about CEOs and with our definition of the control group.

The following extract from the scenario shows how information is presented to participants: “Due to a severe illness, Jacques Dallara, founder and CEO, will be relinquishing his operational duties

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<sup>7</sup> In the discussion of validity issues (see next section), we further discuss our sample choice by explaining why it is appropriate for testing our hypothesis.

soon. At midday, SunCar is expected to announce the name of his successor. The two candidates for the CEO position are Anna Farrell and Henry Villa.” We manipulate the gender of the CEO and set a 50% ex ante probability that a participant faces either of the two variants of the simulation. Regarding firm performance, the company is said to be experiencing an upward trajectory in the months prior to the CEO change. This choice was made to avoid the appointment occurring in a company in crisis (‘glass cliff’ context), which has been shown to lead to the automatic ‘think crisis-think female’ heuristic.

We next present the experiment instructions given to participants and their initial endowment, choice set, incentives and information set. The general instructions were read aloud before the start of the experiment. Participants were asked to act as investors whose objective was to maximize their gains during the trading day. Participants started the simulation with an identical portfolio composed of a combination of cash and stocks.<sup>8</sup>

Similar to traders in an investment bank, the choice set of participants includes decisions about trading (to trade or not to trade), the direction of trading activity (buy or sell stocks), the quantity of stocks bought or sold, the type of order sent (market order or limit order), and the timing of their trading reaction. This set of choices is available to participants throughout the duration of the experiment, which replicates a 24-hour trading day. The whole experiment lasted about 90 minutes with a preliminary trial simulation to familiarize participants with the trading platform and the simulation used for our research.

We next discuss the information set available to participants throughout the duration of the simulation. Our research design, based on a controlled experiment, enables us to minimize the series of informational problems previously discussed and present in archival research.

At the launch of the simulation, participants read that the company is going to announce the appointment of a new CEO. However, they do not know *who* will be appointed; that is, we separate information regarding the appointment of a new CEO and the gender of the newly appointed CEO. This is important because it means that participants are already aware that a new CEO will be appointed when the actual appointment is made public. At the time of the announcement, the only news concerns the name of the appointed CEO, from which participants can unambiguously infer gender (this point was discussed with a student group prior to the

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<sup>8</sup> The initial portfolio of every participant is worth around €60,000. It is composed of cash (€30,000) and 300 shares of SunCar (the only company in the trading environment) valued at approximately €100 in the market.



experiment). Furthermore, in the French context, the names chosen for the CEOs do not have minority connotations related to social class, ethnic group and religious affiliation, which is important since there are minorities other than women among CEOs. Importantly, no information is given to the participants about the qualifications of the candidates: we mute supply-side factors related to female CEOs' formal and informal qualifications and experience. Therefore, the reaction of participants to the CEO appointment can be attributed to a *pure gender effect*. If participants sell following the appointment of a female CEO, this action reflects a dislike of a female CEO precisely because of her gender.

Participants also know *when* the appointment of the new CEO will be made. This is an advantage compared to empirical studies, where researchers face the challenge of determining exactly when investors learn about CEO succession (Malatesta and Thompson, 1985). The information about the appointment is presented as an important piece of information in the ticker displayed on the trading platform. This process aims to maximize market participants' attention.<sup>9</sup> In other words, we minimize the problem of limited attention among traders who may not immediately react to the news (Hirshleifer and Teoh, 2003). Our experimental design also enables us to neutralize the influence of information providers in the financial markets such as financial analysts and the media. Indeed, male financial analysts have been shown to give stock recommendations that are biased against female-led firms (Janati et al., 2020). On the media side, female CEO appointments have been shown to attract higher media attention and different media treatment (Lee and James, 2007 and Dixon-Fowler et al., 2013).

Before launching the simulation, all participants are informed of the news flow that will unfold during the trading day. With respect to the CEO appointment, it is clearly stated that at midday, SunCar will announce the newly appointed CEO. However, before the official announcement by the firm, the participants cannot possibly anticipate the result of the announcement, i.e., whether the appointed CEO will be a man or a woman (no information leakage). Our approach also enables us to disentangle the effect of the CEO appointment from other confounding news items that may affect the reaction of market participants, as the CEO appointment is the only news released at that point in time. Because the timing of announcement is fixed *ex ante* (it is the same regardless of the CEO being appointed and it is announced to participants before the trading day starts), it is therefore independent of the gender of the CEO being appointed, eliminating potential biases

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<sup>9</sup> This was confirmed in a pilot study using an eye tracking tool. The heat map obtained from the data showed that the ticker attracted the attention of the participants.

linked to a strategic timing choice by the firm.

In synthesis, in developing the simulation scenario, we follow a unity of time (precise date of the event), unity of action (unique event) and unity of place (the experimental setting). As in theater, this makes the CEO appointment a *salient* event, allowing us to measure a pure gender effect.

### **3.5 Validity issues**

We now discuss internal and external validity issues to conclude our presentation and discussion of the methodology.

To minimize internal validity concerns, we followed best practices and chose to design a consequential experiment by providing incentives to participants in the form of a bonus on their course grade as a function of their trading performance. We also chose to minimize unwanted demand effects. In particular, we selected a between-subject design to avoid participants second guessing the main variable of interest: CEO gender. Additionally, we conducted the experiment with mixed-gender participants to minimize participants' second guessing of the moderating variable: their own gender. Importantly, while we did not reveal the hypothesis being tested to participants, we told them that the experiment was part of a research project aiming to understand individual financial decisions; thus, we avoided using deception.<sup>10</sup>

External validity relates to the generalizability of the findings of an experiment. Our trading simulation scenario depicts a company that is experiencing an upward trajectory in the months prior to the CEO change. Therefore, our results may not generalize to firms in crisis circumstances; that is, our results are not applicable to the glass cliff phenomenon. The other important aspect of our simulation scenario is the consideration of a setting where the departing CEO is male, which is representative of most CEO transitions and fits our definition of the control group. Therefore, our results may not apply to the study of female-to-female transitions and female-to-male transitions, topics that Zhang and Qu (2016) consider using archival data, despite the less frequent occurrence of such transitions.

Another important aspect related to generalizability concerns the choice of participants and whether they constitute a relevant sample to study our hypothesis. Are business school students an appropriate sample for studying gender and leadership? Beyond the obvious fact that students can be easily mobilized for experiments and incentivized with relatively small stakes, the choice

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<sup>10</sup> Doing so allows to rule out the alternative hypothesis according to which stock market investors, regardless of their own gender, sell stocks when a female CEO is nominated because of her lower intrinsic or perceived ability.

of business school students is particularly relevant for three substantive reasons: work experience, career choices, and acquisition of stereotypes. While students in general have limited work experience, students in French business schools have significant exposure to the corporate world during their compulsory internship period in their first academic year. Corporate immersion for the students in our sample starts in the first term with direct contact with firm top management (“Go pro” experience with the school alumni). Participants in our experiment have, therefore, sufficient work experience and the relevant educational background to analyze corporate news. They also have the knowledge and skills (acquired in the *finance* course) to implement their analysis in their decision to buy and sell stocks in the market on the simulation platform. Regarding career choices, students in our sample come from a leading French business school. They represent a relevant population because they are likely to take on leadership positions, such as that of CEOs, in their future professional careers. Furthermore, an analysis of the specialization choices of our students (finance, marketing, communication, etc.) in their second and third years reveals a choice consistent with stereotypes (e.g., most students choosing the finance track are male). As academic research shows, gender stereotypes and roles are acquired during childhood and persist over time (see, for example, Hicks, Santacreu-Vasut and Shoham, 2015). Therefore, our sample is suitable for studying the effect of preferences towards CEO gender. In that sense, we expect that the qualitative aspect of our results (the direction of the trading reaction revealing the preferences of market participants) is generalizable. For most experimental research, generalizability for the quantitative aspects, involving the amount of stocks bought or sold, is difficult to claim (Kessler and Versterlund, 2015).

To conclude, we do not claim to have designed the perfect experiment, but our choices followed best practices (see Lonati et al., 2018). We develop a rigorous approach to optimize the internal validity of our experiment (consequential experiment, no deception, minimized unwanted demand effects). We also rely on a relevant approach to optimize the external validity using a realistic trading platform and by choosing a relevant sample of participants.

## **4 Data and statistical model**

### **4.1 Data collection and measures**

We collected individual level data for all participants. Before launching the simulation, we asked

participants to fill out a profile.<sup>11</sup> Their entire trading activity (orders sent to the market) and the evolution of their portfolio and trading performance during the simulation were collected via the SimTrade platform. We also collected information regarding the simulation variant faced by each participant (defined by the gender of the CEO appointed during the simulation). From the data collected, we measure the trading reaction of participants following the news about the CEO appointment to construct our dependent variable, the gender of the CEO to define the independent variable manipulated in our experiment, and the gender of the participant to define our moderating variable. Figure 1 illustrates the link between these variables and the theoretical hypotheses.

{Insert Figure 1 about here}

The gender of the CEO and the gender of the participants are coded with dummy variables as follows: *CEO gender* (0 for male and 1 for female) and *Participant gender* (0 for male and 1 for female).

We capture the trading reaction of each participant along two dimensions: qualitative and quantitative. Qualitatively, we consider the trading activity following the appointment of the CEO: buying, selling or not trading stocks. This qualitative measure reveals the positive, negative or neutral evaluation of the appointed CEO. Quantitatively, we consider the intensity of the trading reaction, which provides information regarding *how much* the trader likes or dislikes the appointed CEO.

The trading activity and the trading intensity constitute the two components of our dependent variable. Formally, we define the trading activity as the participant's qualitative decision to buy or sell after the news of the appointment of the CEO or to do nothing. This factor is measured using two variables: *Market participation*, which is a dummy variable equal to 1 if the participant traded after the news and 0 otherwise, and *Order direction*, which is a dummy variable equal to -1 if the participant sold stocks and equal to +1 if the participant bought stocks. We combine these two measures to build the *Trading activity* variable given by Equation (1):

$$\text{Trading activity} = \text{Market participation} \times \text{Order direction}$$

We define the trading intensity as a multifactorial construct to capture how large, how aggressive, and how fast the reaction of the market participant is. The trading intensity includes three factors:

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<sup>11</sup> At the beginning of the experiment, we asked students to read and sign a form explaining the context of the experiment and the use of personal data, as required by the French authority (Cnil) in charge of digital issues. The experiment was also approved by the school's Research Ethics Committee.

1) The quantity of stocks traded, which reveals how *large* a participant increased or reduced investment in the firm after the CEO announcement; 2) The type of order (market order or limit order), which reveals how *aggressive* the participant's reaction was after the announcement; and 3) The time lapse between the CEO appointment announcement and the order sent by the participant, which reveals how *fast* the participant's reaction. Each of these factors is measured with the following variables. *Quantity of stocks* is the quantity of stocks in the buy or sell order. *Probability of execution* is estimated from the type of order (market order or limit order) specified by the participant; it is equal to one for a market order and less than one for a limit order.<sup>12</sup> *Time lapse* is the (inverse) time lapse between the CEO appointment announcement and the order sent by the participant and captures the promptness of the order. A time window is defined to observe the reaction of the participants; *Time lapse* is equal to 1 for an order sent at the beginning of the window immediately after the announcement of the new CEO and to 0 for an order sent at the end of the window. We combine these multiple dimensions to define the *Trading intensity* variable as a sign adjusted-quantity measure given by Equation (2):

$$\text{Trading intensity} = \text{Trading activity} \times \text{Quantity of stocks} \times \text{Probability of execution} \times \text{Time lapse}$$

We now present our control variables. Our first control variable is *Participant gender*, which, in addition to its role as moderator, may have a direct effect on its own. Indeed, extant research shows gender differences in trading behavior. For example, Barber and Odean (2001) study stock trading as a function of gender and find that men and women exhibit differences in their trading behavior that can be attributed to men being over-confident and more optimistic. Other studies have also documented gender differences in the behavior of financial professionals such as traders, fund managers and fundraisers. Eckel and Fullbrun (2015) show that female traders are less prone to generate speculative bubbles, Beckmann and Menkhoff (2008) show that female mutual fund managers are more likely to shy away from competition, and Niessen and Ruenzi (2008) show that female fund managers perform less well than male fund managers. We also include variables other than gender that could explain why a person bought or sold stocks related to academic

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<sup>12</sup> The market environment proposed by the trading simulation platform SimTrade is based on the limit order book. This type of market microstructure is currently the most common structure used by exchanges around the world, as electronic markets are progressively taking over physical markets. In a market with a limit order book, investors can send orders of different types, mainly market orders and limit orders. With market orders, investors want to buy/sell as soon as possible at the market price. With limit orders, investors want to buy at a maximum price and sell at a minimum price (the price limit). With market orders, investors favor quantity over price, as they control the quantity executed; conversely, with limit orders, investors favor price over quantity, as they control the execution price. The use of market orders (compared to limit orders) reflects the aggressiveness of investors in trading.

knowledge in finance and the practical trading skills of the participants for the following reasons. Participants' academic knowledge may correlate with their ability to process information and, therefore, their reaction to the appointment news. To control for this possibility, we use participants' grade in the *finance* course (*Course grade*) as a measure of academic knowledge and a control in our regressions. Similarly, participants' trading performance (their practical trading skills) may also vary by gender, leading to incorrect inference. Therefore, we add participants' trading performance in the simulation (*Trading performance*) as another control variable.

## 4.2 Statistical models and hypotheses

Our theoretical development identified two explanations, potentially concurrent, for the relation between the CEO gender and trading reaction. The first explanation is based on gender stereotypes and is formulated in Hypothesis 1 as follows: "Stock market participants hold gender stereotypes towards CEOs characterized by negative performance expectations towards female CEOs and positive performance expectations towards male CEOs." The second explanation is based on in-group bias and is formulated in Hypothesis 2 as follows "Stock market participants exhibit in-group bias towards CEOs characterized by in-group favoritism towards a CEO of their own gender and out-group discrimination towards a CEO of the opposite gender." While Hypothesis 1 implies that the impact of the CEO gender (our independent variable  $X$ ) on trading reaction (our dependent variable  $Y$ ) is the same for all participants, Hypothesis 2 implies that this impact is moderated by the participants' gender (our moderating variable  $Z$ ).

Statistically, therefore, testing our two theoretical hypotheses requires to study both the impact of our independent variable ( $X$ ) on our dependent variable ( $Y$ ), for Hypothesis 1, and the impact of our moderating variable  $Z$  on the relationship between the independent variable ( $X$ ) and the dependent variable ( $Y$ ), for Hypothesis 2. To do so, we use an interaction term statistical model which is estimated jointly for male and female participants (see Aiken and West (1991) for a detailed presentation of interaction models). Such a model is the appropriate approach to test our theoretical hypotheses because we wish to statistically test the effect of  $X$  on  $Y$  and the joint effect of  $XZ$  on  $Y$  beyond the separate effects of  $X$  and  $Z$  on  $Y$ . This is the case because the effect of gender stereotypes and the effect of in-group bias are possibly concurrent and, therefore, ought to naturally be tested in the same model. As a robustness check we complement our main specification (our interaction model) with a direct comparison between two "simple slopes" models estimated separately for the sub-samples of male and female participants respectively. Testing the difference in the "simple slopes" in the two subsamples allows us to test whether there is a different relationship between  $X$  and  $Y$  for each group  $Z$ . Such an approach has been shown to

provide a more powerful test of the moderation effect due to less severe multicollinearity problems (Robinson, Tomek and Schumacker, 2013).

We estimate two statistical models corresponding to the two components of our dependent variable. For the trading activity, the qualitative component of our dependent variable, we use a multinomial logit model with three categories (-1 for a sell order, 0 for no order, and +1 for a buy order). The odds ratio of the probabilities of two different categories ( $j$  and  $k$ ) for individual  $i$  is a linear function of the explanatory variables given by Equation (3):

$$\ln \left( \frac{\text{Prob}(\text{Trading activity}_i=j)}{\text{Prob}(\text{Trading activity}_i=k)} \right) = \alpha_0 + \alpha_1 \cdot \text{CEO gender}_i + \alpha_2 \cdot \text{Participant gender}_i + \alpha_3 \cdot \text{CEO gender}_i \times \text{Participant gender}_i + \beta_1 \cdot \text{Trading performance}_i + \beta_2 \cdot \text{Course grade}_i + \varepsilon_i$$

For the trading intensity, the quantitative component of our dependent variable, we use the linear regression model given by Equation (4):

$$\text{Trading intensity}_i = \alpha_0 + \alpha_1 \cdot \text{CEO Gender}_i + \alpha_2 \cdot \text{Participant gender}_i + \alpha_3 \cdot \text{CEO gender}_i \times \text{Participant gender}_i + \beta_1 \cdot \text{Trading performance}_i + \beta_2 \cdot \text{Course grade}_i + \varepsilon_i$$

Mirroring our two theoretical hypotheses (Hypothesis 1 about gender stereotypes and Hypothesis 2 about in-group bias), we formulate two statistical hypotheses:

**Hypothesis 1: The coefficient for *CEO gender* is negative ( $\alpha_1 < 0$ ).**

**Hypothesis 2: The coefficient for the interaction term *CEO gender*  $\times$  *Participant gender* is positive ( $\alpha_3 > 0$ ).**

## 5 Results

### 5.1 Descriptive statistics

{Insert Table 1 about here}

Table 1 presents descriptive statistics for the main variables of interest and for the control variables in our sample. Forty-four percent of the simulations have a female CEO being appointed, and 56% of participants are women. A total of 83% of participants reacted to the news of the CEO appointment by either buying or selling stocks. Regarding participants' trading activity, on average, participants sell stocks (the mean of *Order direction* is negative). The average quantity of stocks traded is 42.14, which is approximately 15% of their initial cash for a buy order or of their stocks for a sell order. Participants overwhelmingly use market orders rather than limit orders (average use of 95%). The average standardized time lapse is 0.57, indicating that participants

reacted halfway through the time window defined to study the event. Participants' average course grade is 11.21 out of 20, and while the average trading performance is negative, the standard deviation is high.

{Insert Table 2 about here} {Insert Figure 2 about here}

Table 2 provides descriptive statistics separately for the control group (simulation variant with a male CEO) and the treatment group (simulation variant with a female CEO). Figure 2 plots the percentage of buyers and sellers following the announcement of the appointment of a male CEO (Figure 2A) and a female CEO (Figure 2B).

When a new CEO, either male or female, is appointed, participants tend to sell shares of the company (56%). As shown in Figure 2A, when the appointed CEO is male (control group), participants tend to sell (56%). When disaggregating the results by participant gender, 63% of male participants choose to buy stocks, while 67% of female participants choose to sell stocks. As shown in Figure 2B, when the appointed CEO is female (treatment group), participants tend to sell (57%). This preliminary statistic is consistent with Hypothesis 1 of gender stereotypes which predict that participants evaluate negatively the performance of women in CEO positions. When disaggregating the results of trading activity when a female CEO is appointed by participant gender, we observe that 73% of male participants sell stocks, a statistic that is consistent, again, with Hypothesis 1 of gender stereotypes. On the contrary, 55% of female participants choose to buy stocks when a female CEO is appointed. On average, the behavior of female participants is consistent with Hypothesis 2 of in-group favoritism which predicts that participants evaluate CEOs of their own gender favorably. Next, we formally test our hypotheses using individual-level data in our regression analysis.

## 5.2 Regression analysis

{Insert Table 3 about here}

Table 3 presents our results. The dependent variable is the participant's trading reaction with its two components: the trading activity (Column (1) and Column (2)) and the trading intensity (Column (3) and Column (4)). All specifications include *CEO gender* as our manipulated variable, *Participant gender* as our moderating variable, and *CEO gender*  $\times$  *Participant gender* as our interaction term. Columns (1) and (3) are replicated in Columns (2) and (4), our main specifications, by adding control variables: *Trading performance* and *Course grade*.

Before discussing the empirical test of our hypotheses, we discuss the results concerning the



control variables. Across columns, none of the control variables are statistically significant. In particular, the estimated coefficient for *Participant gender*,  $\widehat{\alpha}_2$ , is negative in all specifications but not statistically significant. The estimated coefficient for *Trading performance*,  $\widehat{\beta}_1$ , is positive in all specifications but not statistically significant. Finally, the estimated coefficient for *Course grade*,  $\widehat{\beta}_2$ , is negative for the specification in columns (1) and (2) and positive for the specification in columns (3) and (4), but not statistically significant.

Hypothesis 1, which is based on gender stereotypes, predicts that the estimated coefficient for the *CEO gender*,  $\widehat{\alpha}_1$ , is negative. While throughout all the specifications the sign of the estimated coefficient is negative, it is not statistically significant, failing to provide direct support for the hypothesis of negative gender stereotypes about female CEO performance as a cause for the gender bias against female CEOs.

Hypothesis 2, which is based on in-group bias, predicts that the estimated coefficient for *CEO gender*  $\times$  *Participant gender*,  $\widehat{\alpha}_3$ , is positive. Throughout all the specifications the sign of the interaction term is positive and statistically significant at the 5% level. When a female CEO is newly appointed, female participants are more likely to buy stocks. In terms of trading activity, the interaction term is positive and equal to +1.712 and is statistically significant at 5 % level. In terms of trading intensity, the interaction term is positive and equal to +40.236 and is statistically significant at 5 % level. This represents the additional adjusted quantity bought by female participants when a female CEO is appointed (about 13% of their initial stock endowment). Therefore, our statistical results for the trading reaction of female participants are consistent with in-group bias: female participants tend to buy stocks when a female CEO of their own gender is appointed, a result which is consistent with in-group favoritism and at odds with negative gender stereotypes about female CEOs. Regarding male traders, the sign of the interaction term implies that they are more likely to buy stocks when a male CEO is appointed and to sell stocks when a female CEO is appointed, which is consistent both with gender stereotypes and in-group bias. That is, our result lends direct support in favor of the presence of in-group bias among female traders, since the two sources of gender bias lead to opposite implications. On the contrary, we are not able to distinguish the source of gender bias among male traders, as both gender stereotypes and in-group bias lead to the same predicted behavior.

We also carry out a test based on a direct comparison of “simple slopes” from two regression models estimated separately for the subsamples of male and female participants to complement our test based on the interaction term. For the subsample of male participants, the “simple slope”

coefficient for *CEO gender* (equivalent to  $\widehat{\alpha}_1$  in the model with the interaction term) is negative and equal to -0.851 for the trading activity, and to -47.367 for the trading intensity. For the subsample of female participants, the “simple slope” coefficient for *CEO gender* (equivalent to  $\widehat{\alpha}_1 + \widehat{\alpha}_3$ ) is positive and equal to +0.844 for the trading activity and +30.682 for the trading intensity. The test based on the difference between the two “simple slope” coefficients is equal to +2.886 for the trading activity and statistically significant at the 1% level ( $p$ -value = 0.002), and +2.897 for the trading intensity and also statistically significant at the 1% level ( $p$ -value = 0.002). This more powerful test corroborates our previous result regarding the significance of our moderating variable (the gender of participants) in support of Hypothesis 2. As discussed in the theory section, this result lends support for the presence of in-group favoritism among female participants towards female CEOs.

## 6 Further analysis

Our results suggest that female traders’ reaction to the appointment of female CEOs is at odds to that observed among male traders and consistent with in-group favoritism, leading us to pose the following question: how would varying gender diversity among stock market participants influence the aggregate market reaction? To answer this question, we calibrate the probabilities of buying and selling using the proportions of buyers and sellers among female and male participants estimated from the data of our experiment (as plotted in Figure 2). In doing so, we assume that individual buying/selling behavior does not depend on the gender diversity among stock market participants, an assumption supported by Eckel and Füllbrunn (2015).

{Insert Figure 3 about here}

Figure 3 plots the difference between the percentage of buyers and the percentage of sellers after the announcement of the appointment of a male CEO (Figure 3A) or a female CEO (Figure 3B) as a function of the proportion of female market participants. This approach enables us to quantitatively estimate the critical threshold of female market participants needed to reverse the sign of the stock market reaction (from negative to positive when a female CEO is appointed and from positive to negative when a male CEO is appointed). This critical threshold corresponds to a gender-neutral market composition, that is, a market where the proportion of buyers equals the proportion of sellers after a male CEO appointment or a female CEO appointment. A departure of the critical threshold from the reference value of 50% indicates a market gender bias. The market gender bias reflects both male and female participants’ gender biases (and their respective sources, gender stereotypes and in-group bias) as revealed by their trading activity and the

hypothetical composition of market participants (the proportion of women participating in the market).

When a male CEO is appointed, the critical threshold of female market participants that makes the market reaction gender neutral is 43% (Figure 3A). When a female CEO is appointed, the critical threshold of female market participants that makes the market reaction gender neutral is 82% (Figure 3B). This means that the market gender bias is larger in magnitude (further away from the reference value of 50%) when the appointment concerns a female CEO (a positive value equal to +32%) than when the appointment concerns a male CEO (a negative value equal to -7%).

In the case of the appointment of a male CEO, the market gender bias (-7%), measured by the difference between the critical threshold of the proportion of female participants of 43% and the reference value of 50%, is explained by the buying activity of male market participants (67%), which outweighs the selling activity of female market participants (33%). When the proportion of female market participants is equal to this critical threshold of 43%, the market reaction to the appointment of a male CEO is neutral (neither negative nor positive bias). With a proportion of female participants lower than this critical threshold, the market reaction to the appointment of a male CEO exhibits a positive gender bias in favor of male CEOs, and inversely, with a proportion of female participants higher than this critical threshold of 43%, the market reaction to the appointment of a male CEO exhibits a negative gender bias in favor of male CEOs.

In the case of the appointment of a female CEO, the market gender bias (+32%), measured by the difference between the critical threshold of the proportion of female participants of 82% and the reference value of 50%, is explained by the selling activity of male market participants (73%), which outweighs the buying activity of female market participants (55%). When the proportion of female market participants is equal to this critical threshold of 82%, the market reaction to the appointment of a female CEO is neutral (neither negative nor positive bias). With a proportion of female participants higher than this critical threshold, the market reaction to the appointment of a female CEO exhibits a positive gender bias towards female CEOs, and inversely, with a proportion of female participants lower than this critical threshold, the market reaction to the appointment of a female CEO exhibits a negative gender bias towards female CEOs.

This thought experiment suggests that our results can explain the negative stock market reaction to female CEO appointments. Indeed, the threshold of female market participants that makes the market reaction gender neutral to the appointment of a female CEO is 82%, well above the current female representation in decision-making positions in the financial sector. Undoing the negative

stock market reaction to female CEO appointments would require a complete transformation of the financial industry by diversifying its workforce. Doing so may require changes in how these occupations are designed to enhance temporal flexibility, one of the key factors explaining the gender pay gap in the corporate, financial and legal worlds, as argued by Goldin (2014). In conclusion, our thought experiment implies that the market is ‘gendered’, meaning that the gender composition of the market participants is not neutral to market outcomes.

## **7 Discussion**

Our study contributes to management research on glass ceiling barriers to the appointment of female CEOs. While most research focuses on barriers internal to the firm, our contribution is to identify a glass ceiling barrier related to the presence of gender biases among stock market investors that poses an external constraint on firm’s management choices. Investors are important for female access to CEO positions because their gender biases can influence their evaluation of the appointed CEO which translates into the selling or buying of stocks and which can strategically influence the firm’s appointment decisions. If the stock market reacts negatively to the appointment of female CEOs, this could discourage firms from appointing female CEOs. Indeed, because stock markets tend to react more negatively to the appointment of a female CEO than to that of a male CEO, decisions made in the stock market may effectively act as a demand-side barrier to female advancement in corporate leadership.

We focus on inquiring on the presence and sources of individual gender biases (gender stereotypes and in-group bias) in stock market price formation; that is, we study investors’ reaction to the CEO appointment at the individual level, which is essential to interpreting aggregate stock market fluctuations in reaction to the appointment of a CEO. We rely on an experimental methodology to causally identify the pure effect of gender. Therefore, our experimental design ensures that participants selling following the appointment of a female CEO reflects a negative evaluation of a female CEO precisely because of her gender.

In our experiment, we observe trading decisions at the individual level in a controlled environment. We build a trading simulation around the appointment of the new CEO that mimics the environment of investors. By randomizing the CEO gender, we can study the effect of the gender of the CEO on the trading activity of the participants as a function of participant gender. We show that the gender of the market participants – a moderating variable - fundamentally changes the relation between the trading reaction of participants and the gender of the appointed CEO. Including the gender of participants in our analysis allows us to distinguish between two

sources of gender bias among female participants, advancing empirical and theoretical research on gender biases in the workplace.

Our theoretical development engages with the existing paradigm of gender stereotypes regarding the negative expected performance of females in leadership roles, according to the ‘Lack of fit’ model, as well as with research about the presence of in-group bias. We find that male participants’ trading activity is consistent with both gender stereotypes and in-group bias, while female participants’ trading activity is consistent with in-group bias. Specifically, we find that male participants tend to buy shares of a company when a male CEO is appointed and tend to sell shares when a female CEO is appointed. The opposite result holds for female participants. Using these results, we quantify the implications of in-group bias among female participants on the relation between gender diversity among stock market participants and the negative stock market reaction to female CEO appointments.

Gender biases including gender stereotypes and in-group bias can help reconcile three major facts: 1) underrepresentation of women in CEO positions; 2) negative stock market reaction to female CEO appointments; and 3) underrepresentation of women in investment positions. The evidence of in-group bias among female traders implies that alleviating the underrepresentation of women in investment occupations could undo the negative stock market reaction, which currently constitutes a barrier to the advancement of women in the corporate world. Indeed, decisions made by investors in financial markets can spillover firms’ decisions on CEO appointments. The gender issue is reflected not only at the corporate level in the need to appoint more female CEOs but also at the financial industry level in the need to increase gender diversity by attracting more women to investment occupations. Therefore, specific policies related to the feminization of those occupations and to the handling of negative leadership stereotypes about female CEOs among male traders must be devised in the financial sector. In conclusion, this paper shows that gender is in the pocket of investors, which implies, at the aggregate level, that the market is ‘gendered’.

Our paper contributes to enrich the big picture about gender bias against female CEOs by analyzing the understudied role of stock market investors and by contributing to the research on gender stereotypes in evaluation settings in the workplace. Our study contributes to the emergence of a coherent picture of the gender issue in corporate leadership by emphasizing the role of gender stereotypes but also of in-group bias (and associated manifestation of gender homophily) at every link of the chain. Media outlets tend to portray the appointed CEOs in a way consistent with gender stereotypes (Lee and James, 2007 and Dixon-Fowler, Ellstrand, Johnson, 2013) which may contribute to the persistence of stereotypes among evaluators regardless of their own gender.

Yet, while extant research has documented the presence of gender stereotypes are equally pervasive across genders (Heilman, 2013), a growing body of work points at the role of in-group bias, which is notably manifested among boards and hiring committees members that appoint CEOs (Powell et al., 2002, Matsa and Miller, 2011), financial analysts that recommend stocks (Janati et al., 2020), venture capitalists that fund entrepreneurs in the primary market (Greenberg and Mollick, 2017, Hebert, 2019), firms that bargain deals in mergers and acquisitions (Levi et al., 2014) and finally, in this paper, among stock market investors that react in the secondary market to the CEO appointments.

Our work has three main policy implications. First, efforts to deal with the underrepresentation of women in leadership positions should also consider interventions in the financial industry and among stock market participants. These can involve structural interventions including unblinding gender in finance education among students, as well as interventions in the financial industry to reveal the role of such biases to decision-makers. These two measures are important for dealing with barriers to female accessing top positions but also for the development of social skills among investors at a moment where non-financial performance becomes increasingly relevant with the rise of ESG and socially motivated investment demands from consumers and regulators. The second policy implication of our finding is that insofar demand-side barriers are an important factor behind the glass ceiling, measures to break those barriers may involve the use of quotas or of remedies that address the fact that regardless of their qualifications, women have a harder time climbing the corporate ladder for reasons outside their control. The third policy implication of our finding is that training programs that aim at dealing with gender stereotypes may benefit from taking into account their interaction with in-group biases. By reinforcing the notion that judgement of men and women is prone to stereotypes, interventions may trigger an increase in the salience of gender as organizing principle of group affiliation. It is therefore important to address gender biases considering both stereotypes and the role of generic group affiliation and their consequences on decision-making. Relatedly, if group consciousness is unaffected by existing diversity or its lack, then, diversifying the financial sector workforce may also contribute to undoing the negative reaction of stock markets to female CEOs appointments.

In future work, research could focus on digging deeper into the mechanisms behind in-group bias among stock market traders. Following Greenberg and Mollick (2017), experiments could manipulate the sector and or industry composition to distinguish between interpersonal choice homophily and activist choice homophily as distinct sources of in-group bias manifested in trading activity. Regarding other avenues for future work, our experiment could be implemented in

different environments, which could help to increase the external validity of our results. In our case, this approach appears to be highly interesting because countries vary greatly in terms of gender inequality both at the societal level and in the financial sector (World Bank Group, 2018). These differences may be a consequence of economic and institutional factors but could also be due to cultural norms (Fernández, 2013) and linguistic variations (Santacreu-Vasut, Shenkar and Shoham, 2014). Our experiment could be implemented in different countries and consider the different cultural and linguistic origins of participants. To that end, the experiment that we developed on the SimTrade platform is available for the research community upon request.<sup>13</sup> Regarding the gender of CEOs, further research could explore how identity dimensions of an individual other than gender, such as age group, handicap status, religious belonging or social class, intersect with gender. Indeed, intersectionality could be explored in our experimental setting by building CEO candidate profiles that vary in these other dimensions. Finally, another line of future work could involve the study of gender as a nonbinary biological and social construct. While in this paper we used a binary representation (male/female) corresponding to the way the current business world portrays gender, scientific research and political activism are increasingly conceiving gender as a continuous spectrum (Ainsworth, 2015). Our experimental setting is also applicable to study investors' reaction to CEOs that belong or self-identify as neither of the two traditional gender categories.

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<sup>13</sup> For more details about the research design and to submit a proposal, visit <https://bit.ly/2xnwMSL>

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## Tables and figures

**Table 1. Descriptive statistics**

	Mean	Standard deviation	Min	Max	Observations
CEO gender	0.436	0.490	0	1	126
Participant gender	0.563	0.502	0	1	126
Market participation	0.833	0.374	0	1	126
Order direction	-0.039	0.915	-1	1	126
Quantity of stocks	42.14	66.97	0	400	126
Order type	0.896	0.305	0	1	126
Time lapse	1.140	0.670	0.000	1.483	126
Trading performance	-6,376	9,818	-47,626	4,761	126
Course grade	11.21	3.31	1.00	18.95	126

*Note:* This table gives the descriptive statistics (mean, standard deviation, minimum and maximum) for the observed variables of the experiment. Participants to the experiment were recruited among the students enrolled in the core finance course at a French business school. The *CEO gender* dummy variable is equal to 0 if a male CEO is appointed in the simulation and to 1 if a female CEO is appointed. The *Participant gender* dummy variable is equal to 0 if the participant in the experiment is a male and to 1 if the participant is a female. The *Market participation* dummy variable is equal to 0 if the participant did not trade after the announcement of the new CEO and to 1 otherwise. The *Order direction* dummy variable is equal to -1 for a sell order and to +1 for a buy order. The *Quantity of stocks* is the number of shares in the buy or sell order. The *Order type* dummy variable is equal to 0 for a limit order and to 1 for a market order. The *Time lapse* is the standardized time-difference between the announcement of the new CEO and the order sent by the participant. The *Trading performance*, measured in euros, is the performance of the participant in the simulation. The *Course grade* is the grade of the participant in the *Finance* course with French grading between 0 and 20.

**Table 2. Descriptive statistics for the control and treatment groups**

	Pooled simulations and pooled participants	Control group: Male CEO simulations			Treatment group: Female CEO simulations		
		Pooled participants	Male participants	Female participants	Pooled participants	Male participants	Female participants
Market participation	0.833 (0.374)	0.873 (0.335)	0.862 (0.350)	0.881 (0.327)	0.781 (0.416)	0.769 (0.429)	0.793 (0.412)
Order direction	-0.039 (0.915)	-0.056 (0.939)	0.103 (0.939)	-0.166 (0.934)	-0.018 (0.374)	-0.230 (0.262)	0.172 (0.889)
Quantity of stocks	42.14 (66.97)	34.23 (42.66)	38.83 (40.67)	31.05 (44.18)	52.36 (88.52)	65.27 (106.60)	40.79 (68.35)
Order type	0.896 (0.305)	0.971 (0.166)	0.931 (0.257)	1.000 (0.000)	0.800 (0.403)	0.961 (0.196)	0.655 (0.483)
Time lapse	1.140 (0.670)	1.204 (0.642)	1.097 (0.673)	1.278 (0.618)	1.065 (0.702)	0.974 (0.672)	1.146 (0.730)
Trading performance	-6,376 (9,818)	-6,654 (10,339)	-7,039 (11,346)	-6,387 (9,717)	-6,018 (9,183)	-4,633 (6,527)	-7,260 (11,010)
Course grade	11.21 (3.31)	11.15 (2.93)	10.82 (2.65)	11.37 (3.12)	11.31 (3.76)	10.78 (3.26)	11.79 (4.16)
Observations	126	71	29	42	55	26	29

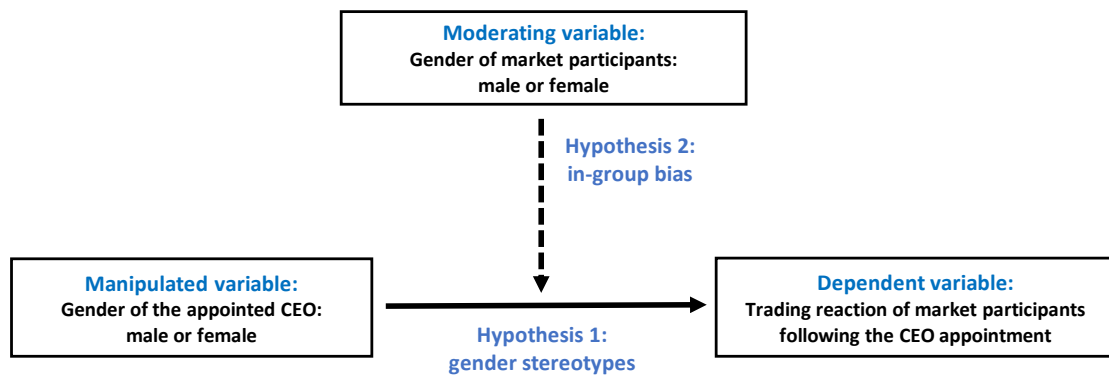
*Note:* This table gives the descriptive statistics (mean and standard deviation below in parentheses) of the observed variables of the experiment for the control group (when a male CEO is appointed in the simulation) and the treatment group (when a female CEO is appointed). Furthermore, for each group, we disaggregate statistics by participant gender (male and female). The *Market participation* dummy variable is equal to 0 if the participant did not trade after the announcement of the new CEO and to 1 otherwise. The *Order direction* dummy variable is equal to -1 for a sell order and to +1 for a buy order. The *Quantity of stocks* is the number of shares in the buy or sell order. The *Order type* dummy variable is equal to 0 for a limit order and to 1 for a market order. The *Time lapse* is the standardized time-difference between the announcement of the new CEO and the order sent by the participant. The *Trading performance*, measured in euros, is the performance of the participant in the simulation in euros. The *Course grade* is the grade of the participant in the *Finance* course with French grading between 0 and 20.

**Table 3. Regression results for the participants' trading reaction following the appointment of the new CEO**

Dependent variable: participants' trading reaction				
	Trading activity		Trading intensity	
	(1)	(2)	(3)	(4)
Intercept	0.241 (0.403)	0.578 (0.817)	2.642 (20.406)	-14.075 (39.240)
CEO gender	-0.860 (0.618)	-0.862 (0.621)	-47.367 (26.679)	-49.737 (29.822)
Participant gender	-0.624 (0.523)	-0.608 (0.527)	-24.957 (26.531)	-26.836 (26.627)
CEO gender × Participant gender	1.685** (0.823)	1.711** (0.828)	78.123* (39.808)	80.472** (40.032)
Trading performance		5.89·10 <sup>-6</sup> (1.96·10 <sup>-5</sup> )		1.02·10 <sup>-3</sup> (1.08·10 <sup>-3</sup> )
Course grade		-0.027 (0.063)		2.210 (2.996)
Pseudo R <sup>2</sup> /R <sup>2</sup>	0.14	0.15	0.03	0.05
Observations	126	126	126	126

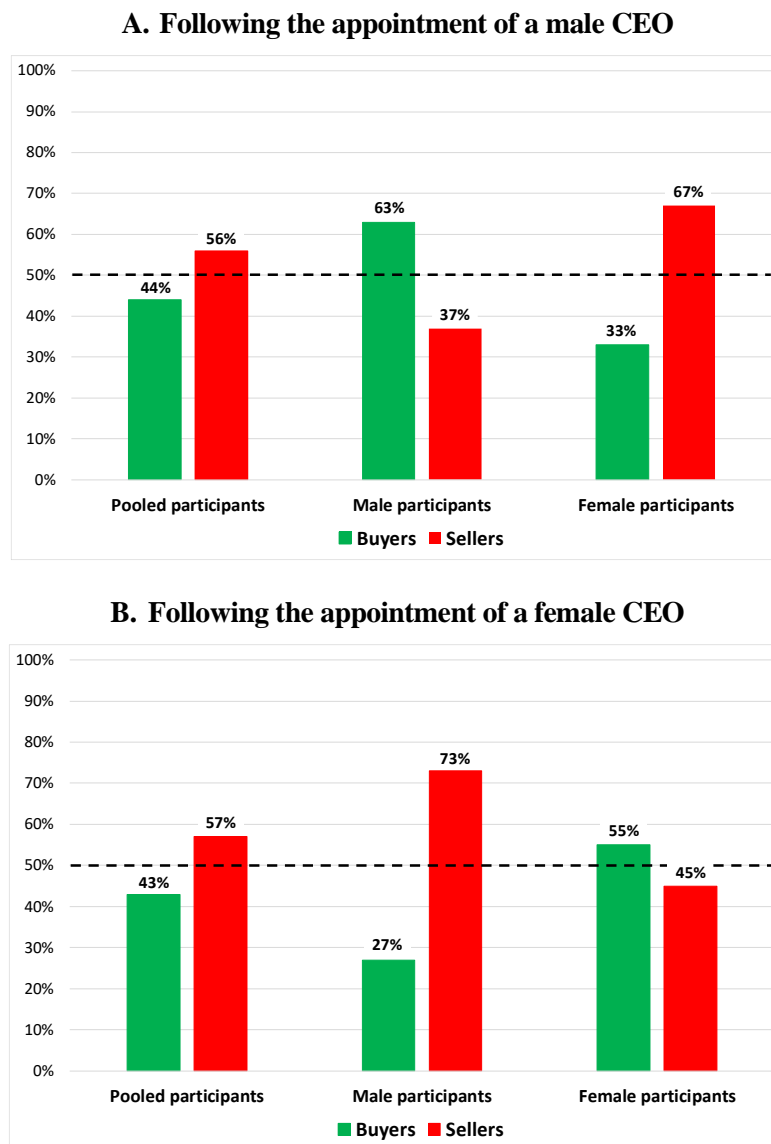
*Note:* This table gives the regression results for the trading reaction of participants (female/male participants) following the appointment of the new CEO (male/female CEO) in the trading simulations. The models in columns (1) and (3) present the results without control variables. The models in columns (2) and (4) present the results with control variables (*Trading performance* and *Course grade*). Standard errors are given in parentheses below the coefficient estimates (following convention, \*\* represents a significant result at the 5% level, and \* represents a significant result at the 10% level). Our dependent variable has two components: the trading activity, which captures the qualitative aspect of the trading reaction, and the trading intensity, which captures the quantitative aspect of the trading reaction. The trading activity is modeled with a multinomial logistic regression (we display the pairwise comparison between the buy order and the sell order—the base case of the model specification). The trading intensity is modeled using linear regression.

**Figure 1. Relation between variables and hypotheses**



*Note:* This figure represents the relation between the dependent, manipulated and moderating variables, and the hypotheses of gender stereotypes and in-group bias.

**Figure 2. Percentage of buyers and sellers following the appointment of a male CEO and a female CEO**

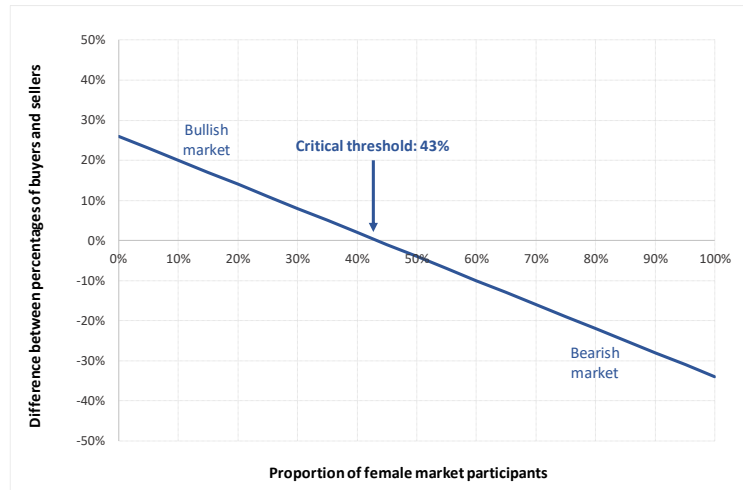


*Note:* This figure plots the percentage of buyers and sellers following the announcement of the appointment of a male CEO (Figure 2A) or a female CEO (Figure 2B).

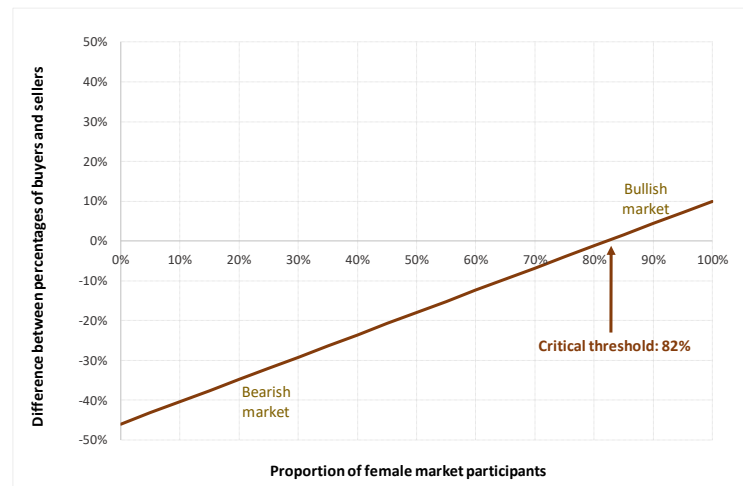


**Figure 3. Difference between the percentage of buyers and the percentage of sellers as a function of the proportion of female market participants**

**A. Following the appointment of a male CEO**



**B. Following the appointment of a female CEO**



*Note:* This figure plots the difference between the percentage of buyers and the percentage of sellers following the announcement of the appointment of a male CEO (Figure 3A) or a female CEO (Figure 3B) as a function of the proportion of female market participants. When the difference between the percentage of buyers and sellers is positive (negative), the market is bullish (bearish). The critical threshold corresponds to the proportion of female market participants needed to have a gender-neutral market reaction to the CEO appointment: a difference between the percentage of buyers and sellers equal to 0%. A departure of the critical threshold from the reference value of 50% indicates a market gender bias. We set the probabilities of buying and selling using the proportions of buyers and sellers among male and female participants estimated from the data of our experiment, as plotted in Figure 2.