

**CESIS Electronic Working Paper Series**

**Paper No. 419**

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investors: Gender, Risk aversion and Observational  
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**Ali Mohammadi  
Kourosh Shafi**

August, 2015

# **The contribution patterns of equity-crowdfunding investors: Gender, Risk aversion and Observational learning**

Ali Mohammadi<sup>1</sup> & Kourosh Shafi<sup>2</sup>

**Abstract:** The scholars and popular news has argued that new form of investment through online platform known as equity Crowdfunding increases the gender equality in financial market for both entrepreneurs and investors. In this paper we investigate whether there are gender-differences in the behavior of investors in firms seeking equity financing in comparison with other settings (e.g. stock market, pension saving). Using data from Swedish equity crowdfunding platform– Fundedbyme, we find that only 20% of investors are female. We also find female investors are less likely to invest in the equity of younger firms, high-technology firms, and those firms with higher percentage of equity offerings. This pattern seems consistent with more risk-aversion of female investors compared to male ones. Furthermore, women are more likely to invest in projects in which proportion of male investors is higher. Overall our result shows that there are not major in pattern of investment between equity crowdfunding and other traditional investment settings.

**Keywords:** Equity crowdfunding; Gender; Herding; Observational learning; Risk-aversion

**JEL Classifications:** G02; G11; G20; M13

**Acknowledgement:** We would like to thank Michal Gromek and Fundebyme team for providing helpful comments and information. We also thank Karl Wennberg, Claire Ingram, and Pardis Nabavi for their thoughtful comments and suggestions.

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<sup>1</sup> Centre of Excellence in Science & Innovation Studies (CESIS), Department of Industrial Economics and Management, Royal Institute of Technology (KTH), 100 44 Stockholm, Sweden. Phone: +46 8 790 7253. E-mail: ali.mohammadi@indek.kth.se.

<sup>2</sup> Department of Management, Economics, and Industrial Engineering, Politecnico di Milano, Piazza Leonardo da Vinci, 32, 20133 Milan, Italy. Phone: +39 328 558 9043. E-mail: mohammadmehdi.shafizadeh@polimi.it.

## INTRODUCTION

Economists have argued that investment behavior is likely to depend on gender (for recent reviews, see Croson and Gneezy 2009 and Bertrand 2011), with supporting evidence coming from experimental studies, choices of asset allocation regarding pension wealth, or managerial firm-level investment decisions (Jianakoplos and Bernasek 1998; Barber and Odean 2001). With accelerating growth in popularity of equity investments now possible via equity crowdfunding platforms, we seek to shed light on whether there are gender-differences in the pattern of equity investments. First, by drawing from an established literature arguing that gender-related differences of investment behavior are due to the risk preferences, we provide corroborating evidence that female investors are more risk-averse as well in equity crowdfunding. This is of great importance as this setting characterizes decision-making under extreme risk relative to prior research settings (e.g., experimental studies, stock market, or pension funds), compounded by limited small investor expertise (Ahlers et al. 2015) in evaluating the adverse selection risks and moral hazard problems involved in equity investments (Gompers and Lerner 2004). Second, by drawing from herding logic, we investigate investment-related decision-making processes associated with gender. This is particularly interesting because researchers are often limited in observing the decision outcomes as opposed to decision-making processes explaining the patterns of investment behaviors. Given that herding is cited to be a prominent feature of crowdfunding markets (Colombo et al. 2015; Vismara 2015; Hornuf and Schwienbacher 2015b), no study has so far attempted to investigate whether there are gender-differences in observed patterns of herding in equity crowdfunding. In sum, our study sheds light on the gender-related drivers of decision-making in the setting of equity crowdfunding.

The setting of equity crowdfunding can provide additional insight into the study of gender-differences in investment behavior. First, Inasmuch as we expect that risk is a

prominent feature of gender difference in investment behavior, our gender-based analysis is likely to be relevant and prominent in equity crowdfunding. To invest in young firms, individuals face high risk and uncertainty about the value of a firm. There is a lot of information asymmetry between the investors and firms, as these firms tend to have limited histories and track record for informed assessment by prospective investors and partners (Stuart et al. 1999). Entrepreneurs tend to be too optimistic or have natural incentive to exaggerate their prospects and the potential value of a firm (Cooper et al. 1988; Busenitz and Barney 1997; Baron 1998), which often is tied to growth expectations rather than tangible assets in place (Shane and Cable 2002; Shane and Stuart 2002). Erroneous valuation of entrepreneurial opportunities is a direct result of these information issues, which is likely to be exacerbated by limited expertise and available resources in addition to incentives to perform due diligence by small investors in equity crowdfunding. Second, equity crowd-funding is nascent, yet fast growing and thus, it raises interesting questions with respect to how to appropriately design these platforms, given that the democratization of access to investment opportunities is especially pertinent for female investors who are under-represented as traditional equity investors such as angels and venture capitalist. Overall, it seems a timely matter to shed light on the behavior of equity crowdfunding participants in general (e.g., Ahlers et al. 2015; Vismara 2015) and in particular, the gender-induced component of this behavior. To illustrate the value and relevance of this research direction, Greenberg and Mollick (2014), for instance, show that structural gender homophily contributes to observed patterns of behavior, and explain the success of crowdfunding projects.

We present two set of evidence regarding the gender-related behavior of investors. First, in line with prior studies claiming that female investors are risk averse, we find that female investors are less likely to invest in high-technology firms, young firms, and those firms with more percentage of equity offered in the platform. Second, we are the first, to the

best of our knowledge, to propose evidence regarding gender-related herding effects. Given robust evidence of the risk-aversion of female investors as well as possible structural homophily in the network of women for sharing information about investment opportunities, one might assume that women are more likely to follow other women in their decisions to invest especially given the risks involved; In contrast, we find that women are more likely to follow men in their investments. There are several plausible explanations from social psychology including (a) the stereotypical view of women as incompetent investors and (b) the gender-induced bias of women in male-dominated fields to favor the decisions of men as the dominant group. These findings only appear valid for female investors since we don't see that male investors follow neither male nor female investors. Moreover, we explore whether favorable firm characteristics moderate the observed pattern of herding so that we can infer rationality of herding behavior (Zhang and Liu 2012). If certificates of firm quality such as receipt of prior seed investment dampen the momentum of herding, we conclude that herding is rational since subsequent investors infer that favorable characteristics drive the momentum as prior investors tend to incorporate this favorable information in their decision set. Drawing on this logic borrowed from Zhang and Liu (2012), in our setting women fail to observe the underlying reasons behind men's decisions for investment and thus, seem to be duplicating men's decisions without being rational observers.

We use data obtained from Fundedbyme, the primary crowdfunding platform in Sweden. Fundedbyme is an online crowdfunding platform, which started in 2011. One year later Fundedbyme added equity crowdfunding to its set of operations and since then, it has launched 40 successful equity campaigns. Our sample consists of 2,537 investments by 1,979 unique investors between 2012 and March 2015.

The paper is organized as following. The next section discusses the theoretical literature on gender related differences in risk-aversion and herding behavior of investors.

Thereafter, we present research setting, data, and analysis. We conclude by discussing our findings and the limitations of this research.

## **THEORETICAL BACKGROUND**

In this section, we develop two set of arguments regarding the underlying gender-related drivers of behaviors with particular focus on investment decisions. We first give a general outline of gender differences as they pertain to the overarching theme of behavioral attitude towards risk perception. This perspective is among the widely popular streams of literature in economics and psychology that explain the determinants of gender-related investment outcomes. Thereafter, we provide arguments regarding differences in herding behavior based on gender. We not only highlight why herding is an appropriate lens to study the sequential investment decisions of crowdfunding participants, but also we propose how gender serves as salient information and helps unpack the decision-making process of individual investors.

### **Gender-differences in risk-taking for investing**

The literature in the psychology and behavioral economics widely investigated gender-based behavioral differences (Eckel and Grossman 2002; Byrnes et al. 1999). In a recent review of this literature on gender differences, Croson and Gneezy (2009) highlight that gender attitudes towards risk are a defining feature of investment decisions<sup>3</sup>. The evidence have accumulated from diverse contexts as this stream views context to be an important boundary condition, mirroring the idea that risk might be conceptually defined and perceived differently in each context. We follow suit and enumerate some of these contexts and definitions of what constitutes risks in these contexts below to further motivate why our exploration in the equity crowdfunding context could provide complementary evidence.

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<sup>3</sup> In this section, we do not explain the underlying explanatory mechanisms in attitude-difference toward risk among men and women (For a discussion of possible social and biological differences, see Croson and Gneezy (2009) and Sapienza et al. (2009)). They are tangential to our core arguments, albeit interesting.

The first group of studies investigate gender-based risk preferences in experimental settings. The experimental studies use probability lotteries and suggest that women are more risk averse than men (Eckel and Grossman 2008; Holt and Laury 2002; Byrnes et al. 1999). Recent findings provide more nuanced contingent views by suggesting that it matters how the financial decision is framed (Schubert et al. 1999) or the racial and sociopolitical biases of participants. For instance, Finucane et al. (2000) in their investigation of sociopolitical biases show that these differences are only observed among whites and no other ethnic groups.

The second set of evidence comes from empirical studies. These studies mostly focus on asset allocation of personal wealth, and report mostly similar results to experimental findings. Sunden and Surette (1998), for instance, studied allocation of assets in defined-contribution plans, and confirmed gender differences in retirement funds investment of men and women after controlling for demographic, attitudinal, and financial characteristics (Bajtelsmit and VanDerhei 1997; Jianakoplos and Bernasek 1998; Bernasek and Shwiff 2001). Allocation between stocks and bonds are usually viewed to reflect risk preferences in this context and thus, larger contribution of pension assets in stocks shows more risk-taking attitude while investment in bonds shows risk aversion (Jianakoplos and Bernasek 1998). Furthermore, Barber and Odean (2001) show that within their common stock portfolios, women hold less risky positions and men trade their risky assets more frequently than women. Relatedly, there is evidence that increasing female investors in markets could alleviate excessive risk-taking by men, and in markets for long-lived assets larger fractions of women reduce the magnitude of speculative price bubble (Eckel and Fullbrunn 2015).

A third stream of literature studies the context of corporate policies and how they are linked to gender of the firm's decision maker(s) such as executives. Whereas these studies tend to suggest mixed results regarding female-led firms and association with risky financial decisions, their departing hypotheses highlight the risk aversion of female compared to male

executives or managers. Faccio et al. (2014) in a large sample of European firms find transition from male to female CEOs is associated with significant reduction in corporate-risk taking (see also, Parrotta and Smith (2013) for similar findings in Danish firms with female CEO and Chair-woman). In this setting, corporate-risk taking is measured by leverage and earnings volatility. Palvia et al. (2014) study capital ratios and default risk of U.S commercial banks and show that female-led banks hold more conservative levels of capital. In a similar vein, Bellucci et al. (2010) find that in Italian local banks female loan officers are more risk-averse<sup>4</sup>. In contrast to these findings, opposing evidence in this line of investigation highlights the relevance of expertise, knowledge, training, and experience as a risk-aversion counterforce for females. For instance, it appears that female *professional* investors show risk-taking behavior at similar rates than those of their male counter-parts. Atkinson et al. (2003) study investment behavior of mutual fund managers and report that male and female managers do not differ in terms of risk preference. Dwyer et al. (2002) find that gender-based differences related to risk aversion of mutual fund investors might be explained by differences in the knowledge of financial markets. In the same vein, research indicates that male and female with managerial training and entrepreneurial experience have similar risk propensity (Johnson and Powell 1994; Masters and Meier 1989; Birley 1989). Likewise, Harrison and Mason (2007) indicate that female business angels are equally interested in investing in technology businesses. In sum, Croson and Gneezy (2009) suggest the gender differences in risk propensity among the general public is more significant than among managers and professional investors.

Equity crowdfunding is a new context in which insights and predictions from gender-related differences in risk-attitude can be applied and be extended. Equity crowdfunding is an

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<sup>4</sup> It is worth noting that “risk aversion” should not be interpreted with negative connotations, in contrast, the corporate governance literature argues the risk aversion leads to more monitoring by female board members and thus, it improves governance and can reduce fraud (Adams and Ferreira 2009; Cumming et al. 2015). Similarly, Palvia et al. (2014) suggest that “*smaller banks with female CEOs and board Chairs were less likely to fail during the financial crisis*” (p. 1).



interesting context as it characterizes risk capital. As discussed in entrepreneurial financing literature, there is a lot of information asymmetry between the investors and firms, as these firms tend to have limited histories and track record to allow perspective investors (and partners) to develop an informed assessment on them (Stuart et al. 1999). Additionally, the value of these firms' is often tied to growth expectations and the qualities and vision of the entrepreneur, while assets in place tend to be a secondary part of the valuation concern (Shane and Cable 2002; Shane and Stuart 2002). Entrepreneurs tend to hold overly-optimistic views of their firms' potential (Cooper et al. 1988; Busenitz and Barney 1997), as well as a natural incentive to exaggerate their prospects, due to the existence of asymmetric information between their firms and outsiders (Ravenscraft and Scherer 1987). Therefore, these issues can result in the erroneous valuation of entrepreneurial opportunities for investors. These problems are more severe for small investors representative of equity crowdfunding investors (Ahlers et al. 2015), meaning that they are less likely to be professional investors with finance know-how and time resources to perform due diligence (Schwienbacher and Larralde 2012). In line with our assumptions about lack of expertise in evaluation of investment opportunities by crowd equity-investors and perhaps lack of incentive due to low-stake holding, and conditional on having invested in at least one firm via equity-crowdfunding, we expect that female investors choose less risky firms compared to male ones.

### **Herding in crowd-based initiatives**

It is unlikely that investors or individuals arrive at their decisions independently from others, rather they update their expectations in a social process by observing others (Bandura 1977). Herding behavior is said to be more frequently observed when there is outcome uncertainty and sequentiality in information production. Both of these conditions appear to be strongly present in equity crowd-funding context (Vismara 2015; Hornuf and Schwienbacher 2015b). We argued previously that there are uncertainties of valuation combined often with lack of

expertise in evaluation of new firms by small investors. Investors are likely to take into account others' decisions given this level of uncertainty, which is compounded by lack of incentives to exert resources to perform due diligence. This might lead small investors to perhaps discount some of the tangible information about the firm that could have been otherwise obtained by careful screening of the information about the firm (presented in the campaign). In order to save cognitive effort and resources from time-consuming or difficult-to-process information such as future financial projections, crowd equity-investors might rely on cues of herding by observing other's decisions. With regards to the sequentially, information cascades by the updated reports on the website, providing information on the funded amount, number of prior investors, the public profile of prior investors. Additionally, backers can sort projects based on the funding amount received, which might encourage herding through easier discovery of well-funded campaigns. Further evidence in the literature attests to the relevance of this theoretical lens to our setting.

There is strong and growing support in favor of herding; which claims that higher number of early contributors increase the success likelihood of crowdfunding campaigns, with evidence from different crowdfunding types such as donation-based (Burtch et al. 2013) reward-based (Colombo et al. 2015), lending-based (Zhang and Liu 2012), or equity-based (Vismara 2015; Hornuf and Schwienbacher 2015b). Some of these studies provide more sophisticated insight into herding by inquiring about a) the type of information obtained from observational learning and b) whether herding is rational or irrational. Herders might not only take into account the percent funded or the number of previous contributors; but also they might attend to important cues such as who the backers/investors are. Vismara (2015) finds that public profile of funders contain salient information regarding the identity of investors and their history of investment activity, all of which can help generate early-momentum and thus, is viewed to explain the role of early momentum of funders to equity campaign success.

As regards rationality, irrational herding is said to occur when individuals passively follow other's choices (Croson and Shang 2008; Simonsohn and Ariely 2008); in which case, observational learning doesn't occur (Banerjee 1992; Bikhchandani et al. 1992). If backers are simply replicating others' backing decisions, they will be irresponsive to how others have arrived at such funding decisions and ignore the characteristics of the project/firm/listing presented in campaign. For instance, Simonsohn and Ariely (2008) find that inexperienced eBay bidders herd into auctions with more bids yet ignore the fact that the swarm of bids results from low starting prices. In case investors are observational learners, their inferences from observing others' funding decisions should be moderated by publicly observed attributes such as the quality certificates of the project. To illustrate this point, Zhang and Liu (2012) find that lenders engage in active observational learning (also here referred to as rational herding), and infer the creditworthiness of borrowers by observing peer-lending decisions such that herding is amplified (dampened) when borrowers have poor credit grades (favorable borrower characteristics).

Likewise, we take into account these two dimensions explicated above and look at the gender-related differences of contributors to investigate whether (a) proportion of prior gender contributors is viewed as information relevant to herding and (b) if this gender-based herding is rational or not. One might argue that women are more likely to follow women in their decision making due to circulation of investment information in common social networks shared by other women; one reason for the emergence of common social networks of female investors might be structural homophily induced by gender as a salient characteristic. Traditional investors of venture capital firms underrepresent significantly women (Greene et al. 2001; Harrison and Mason 2007; Coleman and Robb 2009) and this might lead to barriers in exchange of information regarding investment opportunities for women investors not sharing the same social ties; otherwise said, males investors are viewed

as gatekeepers of investment opportunities, and this process is re-enforced by reliance of male investors on male networks for information and due diligence about investments. There are, however, two reasons to question this logic in our particular setting.

First, there are a number of possible ways that would work against possible tendency of women to follow other women in equity crowd-funding. Equity crowd-funding, at least to a certain extent, removes aforementioned social barriers by reducing search constraints previously facing female professional investors because of open and “democratic” setup of equity crowdfunding. Equity crowd-funding platform lists all the projects on the internet in an open call (Ahlers et al. 2015; Hornuf and Schwienbacher 2015a), broadcasting a similar set of information with the aim of attracting an audience as wide as possible. These features of equity crowdfunding might downsize the importance of network, which used to restrict flow of information about investment opportunity to female investors. Second, prior research indicates that individual’s behavior might be influenced by implicit and unintended biases such as portray of women as less competent than men, stemming from long-term exposure to cultural stereotypes (Devine 1989; Eagly and Mladinic 1994). Women might feel there will be implicit biases against their levels of competence, especially in male-dominated categories/industries (Ridgeway 2009). As such, if we assume women share the same stereotypical views, it is unlikely that women follow other women in this investment setting. Related evidence from audit and experimental studies suggest that women in male-dominated fields (and other minorities in similar positions) might behave with gender-induced bias and favor members of dominant groups at similar rates to those of dominant group (e.g., Moss-Racusin et al. 2012; Nosek et al. 2002; Milkman et al. 2015). Combined together, all these arguments motivate the idea that women are likely to observe the proportion of men, who are viewed as more competent in equity investments, an area which is further male-dominated.

Having highlighted the prominence of gender in the previous section as relevant information noteworthy for female investors' decision-making possibly leading to gender-based herding, we turn our attention to the rationality of herding based on analytical model and arguments of Zhang and Liu (2012). As much as female investors assign the herding momentum to favorable project characteristics such as the certificates of quality, the effect of herding should be dampened. This pattern is likely to indicate that female investors are rationally observing the underlying reason for the herding momentum and their decisions are the result of observational learning (Banerjee 1992; Bikhchandani et al. 1992). Conversely, if the effect of herding is dampened (amplified) in the absence (presence) of favorable project characteristics, then female investors are simply duplicating men's decision without observing rationally what drives their decisions; In this case, female investors would follow descriptive social norms or simply well-funded and salient firms listed on the platform (Simonsohn and Ariely 2008; Croson and Shang 2008). Having said that either mere conformity or rational observational learning can result in herding, we take a step forward to show which mechanism prevails.

## **METHODS**

### **Research setting**

We collect data from campaigns posted on FundedByMe, the largest crowdfunding platform in Sweden (Ingram and Teigland 2013). FundedByMe launched in 2011 and is the first and the largest crowdfunding platform established in Sweden<sup>5</sup>, followed in competition by CrowdCube, CrowdCulture, Toborrow, and Invesdor. FundedByMe offers reward-based,

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<sup>5</sup> In Sweden, there are no specific acts for crowdfunding; however, recently Sweden passed the "Investeringsavdrag", allowing investments into small companies by individuals. Furthermore, while the Swedish platforms do not have any license or permit from the Swedish Financial Supervisory Authority to conduct financial services, the crowd equity platforms are subject to financial supervision and must follow the Swedish Securities Market Act. The most recent statistics ranked Sweden in 6<sup>th</sup> place right after Japan but before China based on the amounts raised through crowdfunding.

loan-based, and equity crowdfunding<sup>6</sup>. This platform started initially by offering reward-based crowdfunding and by the end of 2012 and the early 2015 they also added respectively equity and loan-based crowdfunding to their operations. By September 2014, campaigns on FundedByMe received over € 6.3 million from over 40,000 investors<sup>7</sup>.

The equity crowdfunding platform of Fundedby.me works as following. Firms interested in equity crowdfunding pay € 500 to list their campaign and pay 8% of total money raised if the campaign becomes successful. Platform managers screen each business plan and perform due diligence before allowing campaign go live on the platform. According to FundedbyMe internal documents only about 10% of companies passed due diligence stage and receive permission to go live on the platform. The offerings are usually between €50,000 and € 150,000. All campaigns are based on “all-or-nothing” model (Cumming et al. 2014), meaning that firms only receive the pledged capital if they reach a predefined goal. Fundedby.me communicates information about campaigns through company blog and newsletter emails to registered users.

It is worth noting that although only firms registered in Europe are able to use the platform, over 90% of campaigns so far are from Sweden and other Nordic countries. All registered users from across the world (except USA) can invest in equity campaigns. The registered users can view information on the firm such as a brief description of the reason why firms are offering equity, entrepreneurial team, the social network links, and supporting documents provided by companies such as business description and financial statements. Registered users are also able to observe who has invested and exactly when that investment has happened, although they cannot see how much equity investment that investor has made. Most of the investors use their real name instead of pseudonyms as Fundedby.me encourages this practice (in our sample only about 3 percent of investors used pseudonyms).

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<sup>6</sup> <https://www.fundedby.me/en/what-is-fundedby.me/>

<sup>7</sup> <http://www.crowdfundinsider.com/2014/09/49991-fundedby-me-welcomes-kickstarter-sweden-special-gift/>

## Sample

Our sample is 31 campaigns<sup>8</sup>, which include successful equity crowd-funding campaigns posted on Fundedbyme from the start of equity crowdfunding by Fundedbyme in 2012 to the end of March 2015. We collected firm-information about the campaign from the website of Fundedbyme. We were able to extract the name of investors and the time of investment from activity log of campaigns. We exclude investments made from team members who enjoy private information (we know their names from campaign) to keep a consistent sample in line with our focal investigation. The final sample includes 2,537 investments by 1,979 unique investors.

We took several steps to code genders based on first names. We first algorithmically used the API of genderize.io (a similar procedure used in Greenberg and Mollick, 2014) by providing several country and language inputs such as Swedish, German, and Finish. The algorithm returns the gender and a probability that a specific name-gender attribution (male or female) was correct; in case it cannot decide, the algorithm returns none. In a second step, one of the authors speaking Swedish language double-checked the accuracy of the codes and completed the missing variables, with additional help from the profile picture of the users, LinkedIn and google search (mostly in ambiguous cases such as unisex names).

## Analysis of gender-related risk-taking

*Dependent Variable: Female* is a dummy variable equal to one for female investors and zero for male investors. 20 percent of investments are committed by female investors. The percentage of female investors varies between 4% and 54% per campaign. This is more similar to share of female angel investors in US (Sohl 2014) and smaller than the share of

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<sup>8</sup> They are 40 successful equity crowd-funding campaigns posted on Fundedbyme, however, we were not able to access the activity log and investors names for 9 of these campaigns. We communicated this issue to the helpful team of Fundedbyme, and they also pointed to a transfer from a legacy database as a reason for not showing those investments.

female investors (i.e., 44%) in reward-based crowdfunding campaigns on Kickstarter platform (Marom et al. 2015).

*Independent Variables:* There are several observed characteristics of firms that we hypothesize to show the risk profile of future cash flows. First, younger firms are more risky because nascent firms suffer from liabilities of newness and smallness (Stinchcombe 1965). They have short track record and have had less time to accumulate tangible resources, which increase the risk of investment. *Firm age* is the numbers of years since firm establishment and on average, investors invest in firms with 2.6 years old. The firms of our sample are maximum nine years old. Second, technology category is another proxy for risk. Technology firms are involved in developing and commercializing innovative projects with high uncertainty in outcome (Hall and Lerner 2012). *Technology firm* is a dummy variable denoting 1 for firms operating in technology category such as mobile apps. Technology firms consist 60 percent of the investments and 58 percent of the total firms. Third variable of risk is *equity offering* of the campaign. Leland and Pyle (1977) suggest how firms opportunistically choose to raise equity when managers know their shares are overvalued, and given this, investors perceive equity offerings as a negative signal. Likewise, owner's decision to offer lower amount of equity can suggest better quality of firm in that bad outcome is less likely as perceived by owners (Ahlers et al. 2015). Furthermore, more equity offering can dilute the incentive of entrepreneurs to commit to their firms. Altogether, more *equity offering* is viewed to suggest that a firm is more risky. On average investments are in firms that offer 12.5 percent of their equity and the equity offering varies between 1.6 and 30.2 percent.

*Control Variables:* Several variables might influence the investment decisions of investors. We control the number of prior investors (*No. prior investors*) and the frequency of investments in prior days (*investment rate*). Number of prior investors is on average 85, with a maximum of 365. Investment frequency is calculated as number of prior investors divided by



days passed from start of campaign. These values show the traction of a campaign and how successful it has been so far. The campaigns receive on average 0.8 investments per day with maximum of 5.5. Percentage of days passed (*Share of days passed*) presents the number of days passed from the launch of campaign over its planned duration. Passage of time can provide more information such as the percentage of funding and a forward-looking estimation on whether the campaign will reach its funding goal. The investment takes place on average after 37.5 percent of campaign duration has passed. There are also time-invariant control variables. We group a number of variables representing the quality of firm. *External certification* takes value one if a firm has filed for patent, received seed investment or introduced a lead investor, otherwise zero. Patent shows the capability of R&D staff and technical capabilities of the firm and is viewed as a valuable positive signal decreasing information asymmetry for investors (Hsu and Ziedonis 2013). Affiliation with other organizations increases the legitimacy of the new firm as new firms can borrow the reputation and legitimacy of those firms (Stuart et al. 1999). On average, 52.7 percent of investments are in firms with external certification. Furthermore, we include the natural logarithm of valuation in Swedish Krona (SEK). The valuation of firms varies between 2.1 and 69.9 million SEK with mean value of 26.9 million SEK<sup>9</sup>. Given that entrepreneurs have richer endowment of social capital from their home country (Dahl and Sorenson 2012), we control for location and it is set to one if the firm is located in Sweden, otherwise zero. As female investors are more likely to invest in projects with higher share of female team members due to structural gender homophily (Greenberg and Mollick 2014), we insert a dummy *Woman on Team* that is set to one if there is at least one female member among project team, otherwise zero. Finally, first-time investors on the platform might be systematically different from investors with prior history of investment using this platform in that these investors might include friends and

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<sup>9</sup> During the period from 2013 to 2015, the average of the exchange rate was equal to 7.1 USD/SEK.

family. Thus, *Investment experience* takes a value of one for investors with prior history of funding a firm on the platform and else, zero for first-time investors. Investments made by repeated investors consist 13 percent of investments. To capture possible temporal trends, we insert week day (6 dummies) and year fixed effect (2 dummies) in all models.

*Model Specification.* We perform logit analysis since the dependent variable is binary and use the following specification:

$$Pr(Female=1) = \Phi(\beta_0 + \beta_1.Firm-age + \beta_2.Technology-firm + \beta_3.Equity-offering + \alpha Controls + \varepsilon) \quad (1)$$

The standard errors are robust and clustered around investors to control for non-independence of observations for investors across firms.

*Analysis.* [Table 1](#) reports descriptive statistics of variables in addition to correlation matrix and [Table 2](#) presents the results of logit model.

## Table 1 and 2

Model I shows the base-line specification with only control variables. In model II-IV, theoretical independent variables of risk are added in order. Model V lists all the theoretical variables of interest and results remain unchanged. We also perform formal tests of variance inflated factor (VIF) and conditional index (Belsley et al. 1980) and these tests don't suggest severe issues of multi-collinearity.

In model I, *investment rate* and *investment experience* is negative and significant (respectively,  $p < 0.05$  and  $p < 0.01$ ). It suggests that female investors are less likely to re-invest in a subsequent firm and female investors are more likely to invest in projects with lower investment rate. Turning to theoretical construct, model II shows that older firms are more likely to receive investment from female investors ( $p < 0.01$ ). An increase of one standard deviation from the mean of firm age increases the likelihood of investment from a female investor by 37.5 percent, holding all other variables at mean. Model III indicates that women are less likely to invest in technology-firm ( $p < 0.01$ ). In terms of economic magnitude,

technology firms are 55.7 percent less likely to receive investment from female investors. Finally, Model IV show that more equity offering decreases the likelihood of receipt of investment from female investors ( $p < 0.05$ ). An increase of one standard deviation from mean of the sample (12.56%) will be associated with a decrease of 12.5 percent in the likelihood of investment from a female investor. Model V is inclusive of all the theoretical variables and shows similar results of prior models. These results support that female investors are risk-averse in their decision of equity investment.

### **Herding and gender in equity crowdfunding**

*Dependent variable.* *Number of female (male) investors* in each day is the count of current incremental number of female (male) investors. These variables are logged.

*Independent variable.* *Female share of prior investors* is proportion of investors who are female to total count of all investors until the previous day of campaign.

*Control variables.* We include time varying control variables such as *No. of prior investors* and *Frequency of prior investors*. Number of prior investors is the total count of prior investors until the previous day and *Frequency of prior investors* represents the total number of prior investors divided by number of days passed until the previous day. We also included week-day fixed effects. [Table 3](#) reports descriptive statistics including mean and standard deviation in addition to correlation of variables.

*Model specification.* We identify herding using the following specification.  $y_{jt}$  represents the incremental number of female investors each day (for brevity of arguments, we focus only on female investors as dependent variable in the following description) and  $Y_{j,t-1}$  is the lagged total proportion of female investors and  $X_{jt}$  other observable time-varying attributes related to funding.

$$y_{jt} = \alpha Y_{j,t-1} + \beta_1 X_{jt} + \beta_2 Z_j + u_j + v_{jt} \quad (2)$$

It is unlikely to capture every source of heterogeneity across firms given our available data. For instance, firms could have products that appeal to female investors such as designing fashionable women clothes, or products or services that support socially beneficial products (Harrison and Mason 2007) and this might attract female investors, yet our data don't include a variable denoting the product-category variable. Therefore, the unobserved firm attributes represented as  $u_j$  could consist of, for instance, fashion clothes for women, and as a result, it might be positively correlated with both the proportion of female investors (i.e.,  $Y_{j,t-1}$ ) and the current incremental female investors attracted (i.e.,  $y_{jt}$ ). This would cause endogeneity problems in estimating the effect of  $Y_{j,t-1}$  on  $y_{jt}$  (i.e., coefficient of  $\alpha$  in the equation 2). Therefore, we need to control for unobserved firm heterogeneity with firm-fixed effects to capture the unobserved correlation of preferences among female investors facing the same firm. We assume that  $u_j$  is time-invariant because the firm attributes are unlikely to radically vary from the launch of campaign to the end of campaign. Given the strict multicollinearity between observable time-invariant firm attributes  $Z_j$  with unobserved firm-fixed effect  $u_j$ , the effect of  $Z_j$  cannot be separately estimated. We argued that given website design features such as featuring the well-funded firms and the inclusion of these firms in the newsletter emails subscribed by investors, it is likely that well-funded firms become salient to subsequent investors and give rise to irrational herding (that is said to occur when herders don't engage in rational observational learning of firm quality). The previous equation cannot distinguish between irrational and rational herding because the two mechanisms of (1) observational learning and (2) mere conformity effect result in isomorphic outcomes. By drawing on cross-sectional variation in the publicly observable firm attributes, it is easy to distinguish whether investors are replicating other's decision and ignore how others have arrived at such decisions. Consistent with Zhang and Liu's (2012) operationalization of this idea, we include

the interaction term between lagged proportion of female investors and publicly observable firm attributes ( $Z_j$ ) such as the external certification.

$$y_{jt} = \alpha Y_{j,t-1} + \beta_1 X_{jt} + \beta_2 Z_j + \beta_3 Y_{j,t-1} Z_j + u_j + v_{jt} \quad (3)$$

In the case of rational herding,  $\beta_3$  should have the same sign as firm attributes' main effect on attracting investors (assuming a negative  $\alpha$  as per our theoretical discussion for female investors). As a result of rational observational learning, a subsequent female investor would make more positive incremental quality inference after observing the male-based herding momentum about a firm without external certification. To illustrate further this point, suppose two firms with equal proportion of male investors at time  $t$ . One firm has external certification and the other has no external certification. From subsequent female investors' perspective, male investors must have sufficiently positive information (e.g., private information) or the competence to evaluate better an investment proposal to be willing to fund a not certificated firm. For instance, they might have asked founders for additional information on the business plan and have come to the belief privately that the project is worth investment despite lack of external certification. On the other hand, the decision to invest in a certified firm is easy to justify and doesn't necessarily imply favorable private information on the part of prior male investors. Therefore, it should follow that incremental quality inference about the not-certified firm is higher for the subsequent female investor given the same proportion of male investors at  $t$ . In this sense, we expect that male-based herding momentum to be accentuated by unfavorable firm characteristics and dampened by favorable firm characteristics. As such, if  $\beta_3$  has the same sign as certification effect (assumed positive) for subsequent female investors, subsequent female investors are rational observational learners.

*Analysis.* We present descriptive statistics in [Table 3](#) and the results from fixed-effect regression analysis in [Table 4](#). Model I and II are models with dependent variable set to

number of female investors and Model III and IV are related to number of male investors as dependent variables.

### **Table 3 and 4**

There are two noteworthy results in these models. First, the coefficient of *female share of prior investors* is negative ( $p < 0.1$ ) in model I. Second, the interaction term between *share of female share of prior investors* and *external certification* is negative ( $p < 0.01$ ) in Model II (in this model, External certification is dropped due to the strict collinearity with project fixed-effects). Combined, these results suggest that women are more likely to follow men and this effect is stronger when there is an external certification of the project. The amplified effect of gender-related herding in the presence of favorable characteristics indicate the women are not assigning the gender-related herding momentum to the quality of project, and thus are ignoring the reasons behind male investor's decisions.

We perform the same set of analysis for male investors as the dependent variable in subsequent models; however, we fail to find that men are more likely to follow women as shown in model III. In model IV, we also don't find moderating effect of external certificate for share of female prior investors. Overall, these results suggest differing patterns of gender-related herding for male investors compared to female ones.

### **CONCLUSION and DISCUSSION**

By drawing from gender-associated patterns of investments from equity crowd-funding, we present evidence regarding risk-aversion attitude from female investors. Furthermore, results regarding gender-related herding are novel in that we shed light on the different processes of decision-making for female investors compared to male ones. Our results suggest that women are perhaps biased in their view of competence of other women in equity investing, interestingly resulting in duplicating men's decisions yet ignoring underlying reasons for such decisions.

Our paper has several contributions. First, this study contributes to the literature explicating the role of gender in investment behavior and more specifically, explores gender-differences in herding. Although Sweden– the country of the platform, is ranked high in the list of gender equalitarian countries in the world<sup>10</sup>, yet cultural stereotypes might still persist and thus, we believe there is room to educate women against competence-bias, who happen to suffer from under-representation in managerial positions in firms and in male-dominated fields/industries such as angel investing or venture capitalists. Furthermore, we complement studies that offer insight into the role of risk-aversion based on gender and link these perceptions to investment outcomes. Particularly, it is the first time that the setting of equity investments is used to show how several hypothesized parameters of risk combine to inform the decision of female investors in equity-crowdfunding platform. In this direction, our study is limited in that the observed variables chosen might possibly capture other dimensions relevant to female decision making unrelated to risk (e.g., disposable income), or even unobservable preferences such as desire to support socially beneficial products or services by women investors (Harrison and Mason 2007). We agree with this shortcoming, which is one of the problems of research designs that look at aggregated real-life investment decisions commonly present in prior research. It is therefore helpful to complement our study with field experiments mimicking crowdfunding settings that allow for better identification strategies. Despite this methodological issue, we contend in support of our risk-aversion conviction that (a) equity investment characterizes inherently a decision with high component of risk, and (b) the role of risk perception is obviously stronger and salient for equity crowdfunding participants with potentially limited expertise and resources to evaluate the quality of firms, at least compared to prior empirical settings in asset allocation in bonds and stocks, or lotteries with low-sized stakes. We used several proxies of risk in this context and the results all are

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<sup>10</sup> <http://reports.weforum.org/global-gender-gap-report-2014/>

statistically significant, thus, we cannot argue that our proxies combined are on average always unrelated to risk preferences and we are only observing spurious correlations. Finally, we contribute to the nascent literature on crowdfunding (Belleflamme et al. 2014; Mollick 2014; Colombo et al. 2015; Agrawal et al. 2015; Ahlers et al. 2015; Hornuf and Schwienbacher 2015a). By investigating the gender-related patterns of investment behaviors, we suggest how gender-based risk-preferences play a role beyond the structural gender homophily (Greenberg and Mollick 2014). Further research in this line can uncover the gender relationship between the dynamic patterns of investment and success outcomes of firms in order to explore whether firms perceived to be less risky actually perform better after the campaign, possibly due to the varied provision of monitoring by female investors that could possibly improve loosely-defined governance of crowd equity-funding possible from small shareholders with limited voting rights.

Our results have implications for platform creators. We suggest that platforms facilitate the presentation and digestion of information to investors; For instance, platforms could hire independent third-party professional investors such as angel investors to declare their opinion about valuation of the company, risk factors, and so on. This information might reduce decision bias and attract more female investors.

Future research can benefit from applying other theories of judgment and decision making to offer insights to the domain of equity-based crowdfunding. Acknowledging that decision makers are bounded rational (i.e., plagued by various decision-making biases), and that decisions are typically made based on limited and incomplete information that is further compounded by uncertainty (Dunham 2010; Simon 1979), individuals might use heuristics for judgment. Though heuristics are shortcuts which expedite decision-making and save cognitive resources, they are often inaccurate (Tversky and Kahneman 1973). We know little what cognitive shortcuts, or rules will equity crowdfunding investors employ in their search of



investment opportunities in addition to herding (Wood and Williams 2014). Along with our understanding of decision making from the study of venture capitalists' decision-making (Zacharakis and Meyer 2000), it is interesting to explore questions like whether participants of crowdfunding show overconfidence (Zacharakis and Shepherd 2001) and if so, how this is linked to gender given that women reportedly tend to show lower confidence in some situations (Croson and Gneezy 2009). It is also interesting to explore if framing effects influence the behavior of crowdfunding participants (Kahneman and Tversky 1984), which would involve investigating the reaction of participants to how the information about investment opportunities is presented.

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**Table 1- Summary statistics and pairwise correlation (N=2,537)**

	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1. Female	0.20	0.40	-										
2. Firm age	2.64	2.64	0.14	-									
3. Technology	0.61	0.49	-0.13	-0.53	-								
4. Equity offering (%)	12.56	7.35	-0.01	0.38	-0.10	-							
5. No. prior investors	3.91	1.22	0.02	0.27	-0.08	0.21	-						
6. Investment rate	0.79	1.22	-0.03	0.19	-0.07	0.15	0.24	-					
7. Share of days passed	0.37	0.35	0.03	-0.19	-0.05	-0.10	0.21	-0.42	-				
8. External certification	0.53	0.50	0.00	0.30	0.24	0.06	0.17	0.14	-0.29	-			
9. Woman on team	0.58	0.49	0.05	0.37	-0.03	0.50	0.10	0.14	-0.19	0.32	-		
10. Valuation (ln)	16.73	0.94	-0.03	0.20	-0.23	-0.31	0.38	0.36	-0.31	0.24	-0.21	-	
11. Sweden	0.64	0.48	0.02	0.44	-0.45	0.46	0.32	0.31	-0.20	-0.05	0.43	0.30	-
12. Investment experience	0.13	0.34	-0.19	-0.06	-0.04	0.04	-0.16	-0.03	-0.04	-0.06	0.00	-0.06	0.01

**Table 2- Logit regression analysis. The probability of investment by female investors**

	<b>Model I</b>	<b>Model II</b>	<b>Model III</b>	<b>Model IV</b>	<b>Model V</b>
No. prior investors	-0.052 (0.059)	-0.069 (0.058)	0.026 (0.062)	-0.008 (0.063)	0.085 (0.071)
Investment rate	-0.110** (0.054)	-0.101* (0.053)	-0.085 (0.053)	-0.109** (0.054)	-0.083 (0.054)
Share of days passed	0.160 (0.199)	0.188 (0.201)	-0.090 (0.210)	0.049 (0.202)	-0.219 (0.215)
External certification	0.067 (0.157)	-0.155 (0.162)	0.153 (0.169)	0.153 (0.166)	0.111 (0.183)
Woman on team	0.149 (0.180)	0.064 (0.182)	0.127 (0.193)	0.120 (0.187)	0.028 (0.198)
Valuation <sup>a</sup>	-0.067 (0.083)	-0.062 (0.085)	-0.199** (0.093)	-0.193* (0.110)	-0.392*** (0.124)
Sweden	0.211 (0.178)	-0.148 (0.191)	-0.269 (0.197)	0.396* (0.213)	-0.041 (0.230)
Investment experience	-3.303*** (0.523)	-3.291*** (0.526)	-3.325*** (0.527)	-3.297*** (0.521)	-3.310*** (0.526)
Firm age		0.149*** (0.022)			0.106*** (0.030)
Technology			-0.989*** (0.119)		-0.654*** (0.151)
Equity offering (%)				-0.023* (0.012)	-0.044*** (0.013)
Constant	-1.083 (1.293)	-0.887 (1.321)	1.779 (1.497)	0.784 (1.631)	4.630** (1.875)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Week-day fixed effect	Yes	Yes	Yes	Yes	Yes
N	2,537	2,537	2,537	2,537	2,537
$\chi^2$	65.710	107.021	125.522	71.300	143.587
p	0.000	0.000	0.000	0.000	0.000

Note. In all models robust standard errors are reported in parentheses, \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% level, respectively.

<sup>a</sup> this variable is logged.

**Table 3- Summary statistics and pairwise correlation (N=1,639)**

	<b>Mean</b>	<b>S.D.</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
1. No. female investors (ln)	0.165	0.429	-				
2. No. male investors (ln)	0.477	0.695	0.54	-			
3. No. prior investors (ln)	3.628	1.311	0.05	-0.01	-		
4. Frequency of prior investors	2.861	5.705	0.28	0.34	0.44	-	
5. Share of female prior investors	0.162	0.155	0.26	0.03	0.25	0.07	-
6. External certification	0.485	0.500	-0.01	-0.03	0.23	0.18	-0.02



**Table 4- Fixed-effect panel data regression**

	Model I	Model II	Model III	Model IV
No. prior investors	-0.084*** (0.014)	-0.082*** (0.014)	-0.256*** (0.022)	-0.255*** (0.022)
Frequency of prior investors	0.018*** (0.002)	0.018*** (0.002)	0.045*** (0.003)	0.045*** (0.003)
Share of prior female investors	-0.279* (0.161)	0.002 (0.188)	0.405 (0.256)	0.467 (0.300)
External certification × Share of prior female investors		-0.881*** (0.308)		-0.192 (0.491)
Constant	0.433*** (0.052)	0.447*** (0.052)	1.107*** (0.082)	1.110*** (0.082)
Week-day Fixed-Effect	Yes	Yes	Yes	Yes
N	1,639	1,639	1,639	1,639
Joint F-test (p-value)	0.000	0.000	0.000	0.000

Note. In all models robust standard errors are reported in parentheses, \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% level, respectively.