Interfirm Information Diffusion Differences between Males and Females: Who Diffuses more and Who Benefits?

Mariah Rossi

Submitted to

Central European University

Department of Economics and Business

In partial fulfilment of the requirements for the degree of

Master of Economic Policy in Global Markets

Supervisor: Tomy Lee

Vienna, Austria

2022

Abstract

This thesis addresses differences between males and females in diffusing and receiving rival and less rival information and evaluates how these differences change in the presence of competition. The results show that in general males are better at information diffusion than females, and that females tend to receive the same amount of information as males. Further, that competition significantly decreases information diffusion from males and females, however it only decreases in rival information for males and non-rival information for females. The results also show that females tend to be more sensitive to competition than males. Lastly, there is no evidence of peer effects from informing more group members. This analysis was conducted with RCT data from China, in which managers were put into randomly formed groups of 10 and then were randomly selected to be informed of a product. The effect of information diffusion from males and females respectively is identified from the exogenous variation in the share of informed male and female group members. Heterogeneity analysis determined if females received less information. Competition is incorporated into the model to determine its effect on males' and females' information diffusion strategies. This research adds to the current literature on information diffusion differences between males and females, by providing evidence from randomly formed groups that are devoid of endogeneity problems usually found in other studies on information diffusion. Further, it adds to the literature of how males and females behave in competitive environments.

Acknowledgements:

This thesis would not be what it is today were it not for the wonderful CEU community of students and faculty that encourages critical thinking and academic discourse. I am proud have been given the opportunity take a second look at a successful intervention and gather further insights about how policies affect males and females differently. I am extremely thankful for my supervisor, Tomy Lee, who helped me see the big picture in my results. I have learned so much from your expertise and am happy to have had you as an advisor.

This thesis would not have been possible were it not for the seminal research and outstanding scholarship of Jing Cai and Adam Szeidl. I continued to be surprised by the new insights I gained from studying your research so closely. I am especially grateful to Professor Szeidl who volunteered his time and provided valuable insight and feedback throughout my research.

Throughout this process I have realized how truly blessed I am to have such a wonderful community supporting me. To my delightful peer editors and "thesis buddies" Zsuzsi and Markus, thank you very much for your encouragement and for pushing me to strive and continually improve. To Bálint, thank you very much for your words of encouragement, calming presence, and unwavering faith in me. Lastly, to my amazing parents thank you both very much for subjecting yourselves to reading and editing an applied economics paper, all while managing my other 9 siblings. You two are truly admirable and I am so lucky to have you in my life.

Table of Contents

LIST OF TABLES AND FIGURES:

Main body:

Appendix

I Introduction:

Perhaps the phrase, "It's not about what you know, it's about who you know" will soon become "Who you know dictates what you know," as information diffusion is popularized in public policy. Information diffusion is the process by which information is spread through a network. Research has shown that it has important ramifications for individuals and firms alike.[1] However, before information diffusion becomes a standard political practice, special attention should be noted to differences between males and females in both disseminating and receiving information. It is important to address this issue, because, if it is found that females and males behave differently with information, or females receive proportionally less information than males, it would have significant ramifications on the efficacy and equity of information diffusion policies.

The purpose of this thesis is to investigate differences in information diffusion between males and females. In addition, I will evaluate if females receive the same amount of information as males, if competition plays a role, and if informing more peers of the same gender changes how individuals act on the information they receive.

This paper uses Cai and Szeidl's seminal research on "Interfirm Relationships and Business Performance" as a starting point to address this subject.[2] In their research the authors identified the effect of information diffusion, but did not conduct heterogeneity analysis with respect to female managed firms on this arm of their intervention. I address this gap in their research by measuring

[1]Abhijit Banerjee, Emily Breza, Arun G. Chandrasekhar, and Benjamin Golub, "When less is more: Experimental evidence on information delivery during India's demonetization," *National Bureau of Economic Research*, No. w24679 (June 2018), 3; Jing Cai and Adam Szeidl, "Interfirm Relationships and Business Performance," *The Quarterly Journal of Economics*, Vol. 133, No. 3, (August 2018), 1229–1282; Jing Cai, and Adam Szeidl, "Indirect effects of access to finance," *National Bureau of Economic Research*, No. w29813. (March 2022), 1-74.
[2] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1229–1282.

information diffusion from male and female managers respectively and evaluate whether uninformed female managers received different amounts of information than their male contemporaries.

To do this, I exploit the exogenous variation in male and female informed group members to measure the effect of information diffusion from males and females. I also conduct heterogeneity analysis to determine if uninformed females received different amounts of information from informed managers. Then I analyze to what extent competition within groups change my initial findings. This methodology is driven by Cai and Szeidl's randomized control trial (RCT) design. Their treatment entailed randomly forming groups comprised of 10 managers, and then randomly selecting managers within these groups to receive information.[3] My principal outcome of interest is whether uninformed managers within the groups acted on the information other managers in their group received, which would provide evidence of information diffusion.[4] Results presented herein seek to add to the literature on information diffusion and highlight trends in randomly formed networks with respect to gender and in competitive environments.

My findings provide evidence that males diffuse more information than females in general. They also suggest that there is little heterogeneity in information received by females, nor do I find evidence of homophily in information diffusion. Some of the differences between male's and female's propensities to spread information can be explained by the presence of competition. My results suggest that both males and females decrease their diffusion strategies in the presence of competition, but that females react more to competition on average. Lastly, informed group

[3] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1233.
[4] This is the same outcome of interest as Cai and Szeidl. See Cai and Szeidl, "Interfirm Relationships and Business Performance," 1264.

members are not more likely to act upon the information when more of their peers are informed or more members of the same gender are informed. This implies that there are no detectable peer effects which would influence a manager's decision to act on information. The most important takeaway from these findings is that there are key differences between men and women's information diffusion strategies, which may have important implications for policies with respect to gender equality.

The rest of the paper is organized as follows, in the next section I will describe the current research that is relevant to my study and my contribution to it, then I will describe in detail the context of my research, most importantly, Cai and Szeidl's RCT design, Section II details the empirical specification, section III describes my results, and Section IV concludes with brief policy recommendations.

Current Literature:

The most important literature to my research is Cai and Szeidl's study, "Interfirm Relationships and Business Performance." The researchers organized a RCT on young small and medium enterprises (SMEs) in China. They randomly formed groups comprised of 10 firm managers that met monthly, to measure the effect of interfirm relationships on firm performance.[5] They found significant effects on firm productivity from the intervention and that there was no heterogeneity in outcomes between male and female managed firms in their sample. [6] This suggests that female managed firms benefited just as much as male managed firms from the treatment. Their design will be described in detail in the next section.

[5] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1229.
[6] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1255; Jing Cai and Adam Szeidl, "Online Appendix to Interfirm Relationships and Business Performance," *The Quarterly Journal of Economics*, Vol. 133, No. 3, (August 2018), 2.

The most relevant aspect of their study to my research is their secondary intervention that sought to measure information diffusion within the meeting treatment groups. To measure this, they randomly selected managers to be informed of a government grant or a private savings opportunity. They found that uninformed managers applied for the opportunity, despite not receiving the information treatment, which provided credible evidence of information diffusion. The authors also found that competition played a significant role in information diffusion. The authors gave information about two separate opportunities to measure diffusion of rival and nonrival information in competitive and noncompetitive groups. They evaluated the grant opportunity as "rival" and the savings opportunity as "non-rival," because the grant could be used to directly boost competitors' businesses, notably both opportunities were limited in supply. Their results show that the presence of competition within groups significantly decreased information diffusion in the rival grant opportunity. [7]

My research uses Cai and Szeidl's data and information intervention and adds to the current literature on information diffusion in respect to gender and competition within networks. My research contributes to the literature by providing evidence of information diffusion differences between males and females in exogenously formed networks. In addition, it assesses how their behaviors change in the presence of competition. Most notably to this study, I document differences in information diffusion between men and women in rival and less rival products, and in competitive and less competitive environments. Lastly, my research demonstrates that firms act on the information only if it is relevant to them and is not changed if more of their peers are informed.

[7] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.

Gender is a topic known to economists. There have been numerous studies that analyze "gendered interventions" or policy changes that are aimed towards females.[8] They often evaluate reforms that aid females in breaking into "old boys' networks but give less attention to interventions that affect both males and females.[9] Despite the fact that Cai and Szeidl's treatment is not a gendered intervention, I will employ it to study gender differences in information diffusion. Further, their study is composed of 84% male managers which is informative about information diffusion from and between males and females in a majority male context.

Part of the uniqueness of my research on information diffusion from males and females stems from Cai and Szeidl's RCT design. Other studies on information diffusion largely rely on documenting pre-established social networks and then tracking diffusion through them.[10] In contrast, Cai and Szeidl randomly formed networks, and this enhances my research because this design does not face endogeneity problems typically found in other studies, such as documented differences

[8]Abhijit Banerjee, Esther Duflo, Rachel Glennerster, and Cynthia Kinnan, "The miracle of microfinance? Evidence from a randomized evaluation," *American economic journal: Applied economics*, Vol. 7, No. 1 (Jan. 2015), 26; David McKenzie and Susana Puerto, "Growing markets through business training for female entrepreneurs: A market-level randomized experiment in Kenya," *American Economic Journal: Applied Economics*, Vol.13, No. 2 (April 2021), 297; Marianne Bertrand et al., "Breaking the glass ceiling? The effect of board quotas on female labour market outcomes in Norway," *The Review of Economic Studies*, Vol.86, No. 1 (January 2019), 191; *Inter alia*

[9] Bertrand et al., "Breaking the glass ceiling? The effect of board quotas on female labour market outcomes in Norway,"191; David McKenzie and Susana Puerto, "Growing markets through business training for female entrepreneurs: A market-level randomized experiment in Kenya," 297; Quisumbing, Agnes R., and Neha Kumar. "Does social capital build women's assets? The long-term impacts of group-based and individual dissemination of agricultural technology in Bangladesh," *Journal of Development Effectiveness*, Vol.3, No. 2 (Jun. 2011), 220; c.f. Claudia Goldin and Cecilia Rouse, "Orchestrating impartiality: The impact of" blind" auditions on female musicians," *American economic review*, Vol.90, No. 4 (Sept. 2000), 715.

[10] Abhijit Banerjee et al., "The diffusion of microfinance," *Science* Vol. 341, No. 6144 (Jul 2013), 363; Maksim Kitsak et al., ""Identification of influential spreaders in complex networks," *Nature physics* Vol.6, No. 11 (Aug. 2010), 888; Eytan Bakshy et al., "The role of social networks in information diffusion," *Proceedings of the 21st international conference on World Wide Web*, (April 2012), 519; Sinan Aral, Erik Brynjolfsson, and Marshall W. Van Alstyne, "Productivity effects of information diffusion in networks," *MIT Sloan School Working Paper*, 4683-08, (July 2007), 1. Lori Beaman, and Andrew Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," *Journal of Development Economics* Vol.133 (July 2018), 147; Abhijit Banerjee et al., "Come play with me: Experimental evidence of information diffusion about rival goods," *Working Paper*, (August 2012), 1.

between male's and female's networks.[11] Instead of mapping a pre-existing network and then informing certain individuals, this study randomized both the formation of the network and who received information. Due to this randomization, the results in my paper are not confounded by pre-existing differences between male and female networks or pre-established roles within a network. Therefore, these results are less context specific than previous studies.

Current literature on information diffusion emphasizes that some people are better at it than others, meaning they spread more information to more people within their networks.[12] In their empirical research and information diffusion model, Banerjee et al. emphasizes the importance of a person's "communication centrality" for information to be effectively spread within a network.[13] Cai and Szeidl's methodology differs slightly in that they did not inform people who were "best" at communicating information; rather, managers were randomly selected and were equally as likely to receive the information within groups. This, too, enables my study to detect gender trends in information diffusion. My research avoids "network structures [that] exhibit a tendency for central nodes within the network to be of only one gender, [in which] the diffusion of information through social networks may reinforce existing gender informational inequality."[14] Rather than established central nodes, these networks were composed of similar individuals in management positions in new relationships with one another. This in turn, provides a unique setting that does not assess the

[11] Beaman and Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," 148; Related literature is on female's ability to leverage their own social networks in the labor market, findings suggest they do not leverage them as effectively as men see: Linda Datcher Loury, "Some contacts are more equal than others: Informal networks, job tenure, and wages," *Journal of Labor Economics* Vol. 24, No. 2 (2006), 299; Marie Lalanne and Paul Seabright, "The old boy network: Gender differences in the impact of social networks on remuneration in top executive jobs," *CEPR Discussion Paper,* No.DP8623 (Nov. 2011), 1.
[12] Banerjee et al., "The diffusion of microfinance," 363; Maksim Kitsak et al., "Identification of influential spreaders in complex networks," *Nature physics* Vol.6, No. 11 (Aug. 2010), 888.
[13] Banerjee et al., "The diffusion of microfinance," 363.
[14] Beaman and Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," 148.

ability of "central nodes" to diffuse information. Rather, it allows me to distinguish general trends in the diffusion habits of males and females.

That said, differences in information diffusion ability between males and females has been documented.[15] Banjeree et al. found that when community members were asked who they thought were the "best gossips" in their network, they predominantly chose male community members.[16] Likewise Beaman and Dillon found that male group members had higher "betweenness" and "degree centrality" than females, suggesting males were more connected and had more influence in their networks.[17] These studies demonstrate that in established networks, males tend to be more connected and better at diffusing information than females. However, this is not necessarily the case in newly and randomly formed groups, therefore I investigate the determinants of gender differences in information diffusion within this unique context.

How information is spread is one aspect of diffusion, another is who among the uninformed obtains that information. My research also investigates if there is heterogeneity in respect to females' receipt of information. Similarly, Beam and Dillon found that women tended to receive information less often than men in both rival and non-rival products.[18] They attributed a large part of this finding to women being on the periphery of established networks.[19] In addition, there is also documented evidence of homophily in pre-existing networks, in which members of the same

[15]Abhijit Banerjee et al., "Using gossips to spread information: Theory and evidence from two randomized controlled trials," *The Review of Economic Studies* Vol.86, No. 6 (Nov. 2019), 2467; Beaman and Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," 155; Yinying Wang, Nicholas J. Sauers, and Jayson W. Richardson, "A social network approach to examine K-12 educational leaders' influence on information diffusion on Twitter," *Journal of School Leadership* Vol.26, No. 3 (May 2016), 515.
[16] Banerjee et al., "Using gossips to spread information: Theory and evidence from two randomized controlled trials," 2467.
[17] Beaman and Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," 155.
[17] Ibid.
[18] Ibid.
[19] Ibid.

gender diffused more information to each other.[20] These findings provide evidence of differences in information receipt by women as well as preferences to diffuse to members of the same gender making this an equally relevant aspect of my research.

Gendered differences are one of many aspects that change information diffusion, for example, it has been documented to decrease in competitive environments.[21] Information is considered "rival" if it loses value as more people know it.[22] Naturally, there are more instances of rival information between competitors, in which it may harm one competitor to share information with another. Hardy and McCasland's research provided credible evidence that competition caused information diffusion to decrease in Ghana in a majority female sample.[23] It is not always the case that information diffusion does not occur among competitors, but it certainly plays a role in the extent of diffusion.[24]

The last related point is the behavior of informed members and if it changes as more of their peers are informed. Rogers emphasizes the "s-shaped curve of diffusion," in which early adopters of an innovation are soon joined by "more and more individuals."[25] In contrast, Banerjee et al. found a lack of an "endorsement effect" in which informed members were not more likely to use microfinance if they were informed by adopters, suggesting that individuals' decisions to

[20] Morgan Hardy, and Jamie McCasland, "It takes two: experimental evidence on the determinants of technology diffusion," *Unpublished paper, University of British Columbia*, (Sept. 2016), 33.
[21] Morgan Hardy, and Jamie McCasland, "It takes two: experimental evidence on the determinants of technology diffusion," 21; Banerjee et al., "Come play with me: Experimental evidence of information diffusion about rival goods," 4; Beaman and Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," 155.
[22] Jeremy C. Stein, "Conversations among competitors," *American Economic Review* Vol.98, No. 5 (Dec. 2008), 2160; Nicole Immorlica, Brendan Lucier, and Evan Sadler, "Sharing rival information," *Working paper* (Nov. 2014), 1.
[23] Hardy and McCasland, "It takes two: experimental evidence on the determinants of technology diffusion," 21.
[24] Jeremy C. Stein, "Conversations among competitors," 2150.
[25] Everett M. Rogers, *Diffusion of innovations* (Simon and Schuster, 2010), 23.

participate in a program are not influenced by bandwagon appeal from others.[26] Although these seem to be contradictory, Rogers emphasizes that it takes time for more people to adopt new innovations as first movers cannot learn from others' experiences with the information.[27] Xiong et al. ascribes this to two effects, the "information effect" which an individual only acts on if it is not difficult to evaluate costs and benefits of the information, and the "experience effect" when informed members wait until others have experience with the information before they act on it.[28] Since I only have data from one time period, the "information effect" is most relevant to my research as peers' experiences are unobservable.

Although gender differences, effects of competition, and peer influence have been discussed in other contexts as explained above, this paper exploits a unique case study that demonstrates all these phenomena in a randomly formed network with randomly informed individuals. This randomization design means that my results are not confounded by problems faced by interventions that only affect females or target pre-established networks. In this way, some of the observed differences between my results and those of other works can be ascribed to differences in contextual settings and highlight that existing network trends are not necessarily entrenched into new randomly formed networks. I seek to continue the conversation surrounding information diffusion with an emphasis on the ways males and females engage in it in competitive and uncompetitive environments. To my knowledge this is the only study that compares these differences in a randomly formed network with credible identification of competition within these networks.

[26] Banerjee et al., "The diffusion of microfinance," 370.
[27] Everett M. Rogers, *Diffusion of innovations* (Simon and Schuster, 2010), 23.
[28] Hang Xiong, Diane Payne, and Stephen Kinsella, "Peer effects in the diffusion of innovations: Theory and simulation," *Journal of behavioral and Experimental Economics* Vol.63 (Aug. 2016), 4.

Context and Data:

This paper uses Cai and Szeidl's RCT midline survey data to explore information diffusion between male and female managed firms.[29] Their study took place in 2013 in Nanchang, China and consisted of 2,820 young, micro, small, and medium enterprises who volunteered for the study. Contingent upon the firm's subregions they stratified the firms based on industry and size and then randomly assigned them into groups thereby, "ensuring that conditional on the firm's strata and subregion, the peers of the firms were random."[30] There are 141 monthly meetings groups in the dataset and are comprised of 10 managers each. Their main "meetings intervention" found that firms in the meetings treatment had increased sales and profits among other indicators and improved management practices within firms.[31] Their results highlight the importance of interfirm relationships on business performance.[32]

A secondary intervention that the researchers conducted was used to measure information diffusion among firms and as mentioned, will serve as the basis for my research. To do this they passed on information "about two relatively unknown financial products to randomly chosen managers."[33] One was a government grant that "awarded up to RMB 200,000 (about $32,000 at the time)."[34] The other was a savings opportunity which offered an above average market return

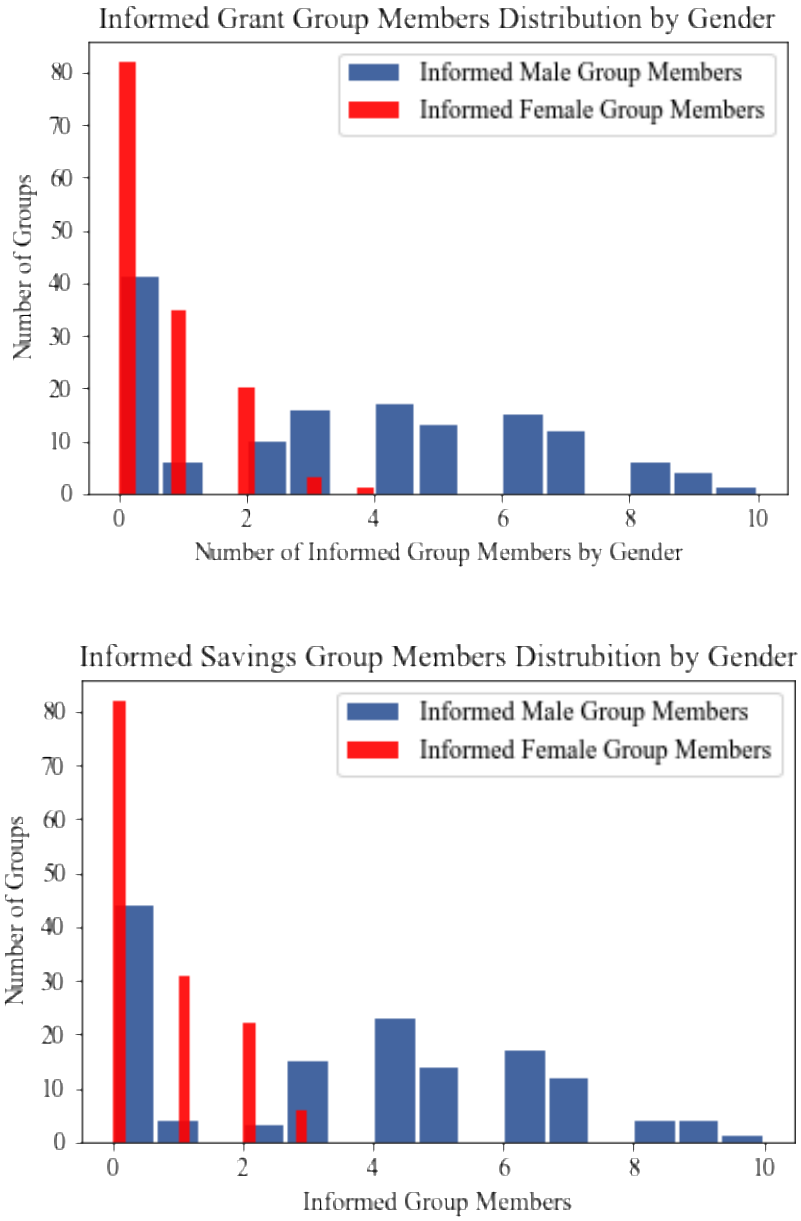
[29] Cai, Jing; Szeidl, Adam, *Replication Data for: 'Interfirm Relationships and Business Performance',* V1 (December 08, 2017), distributed by Harvard Dataverse, https://doi.org/10.7910/DVN/5ZX8ZI.
[30] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1256.
"The stratification is as follows; (1) in each of the 26 subregions firms were divided into four strata (a) small service, (b) big service, (c) small manufacturing, and (d) big manufacturing. (2) In each stratum of each subregion [they] randomly ranked firms. (3) In each subregion [they] created an assignment that mapped firms by their strata and rank into business groups of different types. (4) Using the random rankings, [they] implemented the assignments."
[31] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1231.
[32] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1230.
[33] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1238.
[34] Ibid.

of 7% annually.[35] Both opportunities were limited in supply.[36] The authors consider the grant opportunity to be a rival product, as it could be used to directly boost a competitor firm's business, while the savings opportunity may have been viewed as less rival.[37]

The information was given to randomly selected managers in February of 2014, 6 months after the first monthly meeting in 2013. "It was distributed by phone calls and text messages to 0%, 50% or 80% of the managers in each meeting group and 40% of control firms."[38] The randomization of information about the two products were conducted independently of each other. Firms were surveyed to see if they applied either for the grant or the savings opportunity in the midline survey conducted in August of 2014.[39] Of the 1,062 randomly selected managers who received information about the government grant opportunity, 176 were female, 88 of whom were in the meetings treatment group. For the savings treatment of the 1,078 randomly informed managers, 182 were female, and 93 of whom were in the meetings treatment group. Figure 1 displays the distribution of informed group members by gender. The top figure shows the number of groups that have 0 to 10 male or female informed group members under the grant treatment. Likewise, the bottom figure shows the number of groups with 0 to 10 male or female informed group members under the savings treatment. It is clear from my figure that there are many groups with no female informed group members, and if they are informed, it is most frequently only one member.

[35] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1239.
[36] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1264.
[37] Ibid.
[38] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1239.
[39] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1236.

Figure 1: Informed Group Members by Gender



Cai and Sziedl found that managers in meeting groups who did not receive the information but had an informed group member were more likely to apply for a loan than those in groups with no informed members.[40] They attribute this to the effect of information diffusion. Further, they

[40] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1267.

evaluated whether having competition impacted information diffusion, and found it had a negative and significant impact for the "rival" grant application.[41] Competition was measured as an indicator for "higher-than-median level" of product market competition in the group of *i*, which was "defined by first computing the average number of in-group competitors of firms in a group (self-reported at their midline survey); and then splitting the set of groups by the median of this value."[42] It is important that firms self-report on the presence of competition, because in this way it is felt by group members, rather than an objective measure of market competition. It should also be noted that females are not more likely to be in competitive groups than men.[43]

However, their analysis did not evaluate information diffusion by the gender of those who diffuse and receive the information. Therefore, my analysis will detect the effect of information diffusion for each additional male or female group member informed, the associations between the number of males/females informed and applications from uninformed female managers, and if the presence of competition affects these findings.

Cai and Szeidl's study compared balance between the treatment meeting and control groups using their 2013 baseline survey results. They reported that the two groups are balanced.[44] However, since this paper will concentrate on male and female managers it is relevant to compare these two groups. Summary statistics and differences between male and female managed firms are included in Table I Panel A and B.

[41] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1268.
[42] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1265.
[43] This is true for females generally and for uninformed females in the grant opportunity, savings opportunity, or both.
[44] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1242.

Table I: Summary Statistics by Female and Male Managed Firms

	Male Average	Female Average	Difference	P-Value
Number of Observations	2227	419		
Panel A: Firm Characteristics				
Firm Age (years)	2.324	2.439	-.115	.216
Private Ownership (%)	.975	.981	-.005	.52
Manufacturing (%)	.506	.447	.06	.025
Service (%)	.467	.54	-.074	.005
Number of Employees	38.137	25.811	12.325	.007
Panel B: Managerial Characteristics				
Age	41.23	38.735	2.496	0
College (%)	.289	.304	-.015	.544
Worked for government (%)	.237	.181	.056	.013
Party Member (%)	.228	.086	.142	0
Panel C: Partnership				
Number of Clients	45.498	47.967	-2.469	.42
Number of Suppliers	16.645	14.995	1.649	.108
Panel D: Borrowing				
Bank Loan (%)	.258	.215	.044	.06
Informal Loan (%)	.124	.11	.014	.416
Revenue	1664.50	1211.044	453.456	.189
Panel E: Accounting				
Log Sales	5.705	4.999	.707	0
Net Profit	83.948	54.58	29.368	.007

Notes: Data is from the 2013 baseline survey. Managers self-reported gender (1=Male, 2=Female). The survey reports on firm averages by gender. Private ownership, manufacturing, service, college, worked for government, party member, bank loan, and informal loan are all binary variables. The decimal reported can be converted into percent form and interpreted as the share of firms with these attributes.

In Table I and Figure 1 we can observe that there are significantly more male managers than female managers in the study (2227 vs. 419 firms). Female managers are more concentrated in the service sector, have fewer employees, are less likely to have worked for the government or be a party member, but are just as educated as male managers. Further, female, and male managers have a

similar number of clients, revenue, and informal loans, but females have marginally smaller numbers of suppliers, bank loans, sales, and net profit. It is reasonable to conclude that male and female firms are categorically different from one another. This sample reflects other findings of productivity gaps between male and female managed firms.[45] Importantly, in the study, treatment and control groups did not differ significantly in their share of female managers.[46]

Relevance of Information to Male and Female Firms:

Most important to this research is whether there are detectable differences between male and female managed firms in how often they report applying for either opportunity. If there are detectable differences between male and females, it would suggest that the information does not bear the same relevance between them, and would confound my analysis on information diffusion. To test this, I used the following specification:

(1) $Applied_i = Const + \gamma_1 * Information_i + \gamma_2 * Information_i * Female_i + \varepsilon_i$

Where the dependent variable is an indicator for whether manager i reported having applied for the grant or loan product. The constant is the average share of applications from uninformed managers. Coefficient γ_1 measures the average effect of the information on the share of applications for male managers, and γ_2 is the coefficient of interest and measures the average effect of receiving information for females. If γ_2 is statistically significant it would suggest that males and females who receive the same information act differently. This would confound my information diffusion results demonstrated later in the paper. ε_i is the error term. Standard errors

[45]Asif Islam et al., "The labor productivity gap between female and male-managed firms in the formal private sector," *World Bank Policy Research Working Paper* No.8445 (May 2018), 1;
Elena Bardasi, Shwetlena Sabarwal, and Katherine Terrell, "How do female entrepreneurs perform? Evidence from three developing regions," *Small Business Economics* Vol.37, No. 4 (Oct. 2011), 417.
[46] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1242.

are clustered at the meetings group level for firms in the treatment group as errors may be correlated within the treatment groups, and at the firm level for firms in the control group.[47]

Table II: Applications from Informed Group Managers

	(1)	(2)
Independent Variable	Grant Application	Savings Application
Information	0.301***	0.396***
	(0.0216)	(0.0188)
Information*Female	-0.0159	0.0154
	(0.0576)	(0.0263)
Constant	.135	.462
	(.0133)	(.0147)
Observations	2,628	2,628

Notes: This table uses Cai and Szeidl's midline survey data. The sample includes all firms in the data. Robust standard errors are in parentheses and clustered at the group level for firms within the meetings treatment group and at the firm level for firms in the control group. *** p<0.01, ** p<0.05, * p<0.1

Results in column (1) and (2) both demonstrate that there is no significant difference in the share of applications from male and female managers for either opportunity. This demonstrates that these opportunities are equally relevant to female managed firms despite the documented differences above. This provides evidence that any difference in information diffusion to females is not driven by observed propensities to apply.

[47] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1247.

II Empirical Specification

To evaluate the differences in information diffusion between males and females, I measure the effect of informing an additional male or female group member on applications from uninformed managers within the meetings groups. Further, I detect whether there are differences in information diffusion to females by interacting the previous terms with uninformed female managers. My main estimation specification is as follows:

$$(2)\ Applied_i = \beta_1 * Number\ of\ Male\ Group\ Members\ Informed_{Gi} + \beta_2 * Number\ of\ Female\ Group\ Members\ Informed_{Gi} + \beta_3 * Number\ of\ Males\ Group\ Members\ Informed_{Gi} * Uniformed\ Female_i + + \beta_4\ Number\ of\ Female\ Group\ Members\ Informed_{Gi} * Uniformed\ Female_i + Controls + \varepsilon_i$$

Where *i* represents the uninformed manager in meetings group *G*. The independent variable is whether uninformed manager *i* reported applying to either the grant or savings opportunity. Coefficient β_1 estimates the average effect of an application from manager *i* for each additional male informed from their group *G*, and β_2 measures the average effect from manager *i* for each additional female informed from group *G* about the opportunity. Coefficients β_3 and β_4 estimate the association of each additional male or female group member informed on average uninformed female applications. In particular, β_3 measures the average application rates for uninformed female managers for each additional male group member informed and β_4 measures the application rates for female managers for each additional female group member informed. Simply put, they measure to what extent uninformed female managers experienced differences in information diffusion from males and females. $Controls$ include firm demographic controls, discussed in detail below, and

ε_i is the error term, standard errors are again clustered at the group level, as errors may be correlated within treatment groups.[48]

Cai and Szeidl's paper used firm demographics as a set of controls for their estimates of information diffusion to uninformed firms. These include: "indicators for subregion, sector categories, and size categories at baseline, and their interactions."[49] They employed these controls because randomization into groups was conditioned on them, by their inclusion they isolate the variation in $Competition_G$, which was driven by the random variation in group composition.[50] Likewise, controlling for these variables allows my estimates to identify the effect of each additional informed male and female due to the randomness in gender group composition. Although female managers tend to be more concentrated in the service sector and smaller enterprises, these relationships are not perfectly collinear as not all female managers firms are small or in the service sector which is demonstrated by the averages displayed in Table I. Thereby allowing this effect to be identified.

The results of regression (2) are included in Table III which indicate differences between males and females in information diffusion and detects whether females in the sample experienced less diffusion than males.

[48] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1247.
[49] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1242.
[50] Ibid.

III Results

My results show in that informing more male managers increases applications from uninformed group members in both the grant and savings application. Informing more females only increases application for the savings opportunity and has no effect on the grant opportunity. In general, there is little evidence of heterogeneity in information received by uninformed females.

When I add interaction terms with competition, information diffusion decreases from males in the grant opportunity, but not the savings opportunity. For females, it decreases information diffusion in the savings opportunity. My findings also suggest that females are more sensitive to competition than males. Further, I again find little evidence of heterogeneity in information received by uninformed females, though some results point to receiving less information from other females.

Lastly, I find no evidence of peer effects. There are no differences between males and females' likelihood in being awarded the grant, nor differences between competitive and uncompetitive groups. Which suggests that different types of groups or applications from females did not change the caliber of applications in the grant opportunity. Lastly, I find no evidence of peer effects for informed managers. Informing more managers, or managers of the same gender does not increase the likelihood of applying to either opportunity for informed managers.

Information Diffusion Differences between Males and Females:

Table III: Applications from Uninformed Managers in the Meetings Treatment Group

Independent Variable	(1) Grant Application	(2) Savings Application	(3) Pooled Applications
Number of Male informed Group Members	0.0350***	0.0535***	0.0598***
	(0.00940)	(0.00750)	(0.00914)
Number of Female Informed Group Members	0.0350	0.0554**	0.0280
	(0.0388)	(0.0247)	(0.0344)
Number of Male Informed Group Members* Female	-0.00491	-0.00579	-0.00825
	(0.0146)	(0.0162)	(0.0144)
Number of Female Informed Group Members* Female	-0.0546	0.00206	-0.102*
	(0.0599)	(0.0766)	(0.0532)
Observations	842	831	1,030
Firm Demographic Controls	Yes	Yes	Yes

Notes: The sample is for all uninformed firms in the meetings treatment group from the midline survey data. The pooled data observes firms twice, once for the grant application and once for the savings application, the independent variable is a single indicator of whether a manager reported applying to either one. "Firm demographics are firm size category, sector, subregion, and their interactions." [51] Robust standard errors are clustered at the group level and included in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

The results above indicate that for each additional male informed in the group, uninformed managers are more likely to apply for both the savings and grant opportunity. This effect was also found in Bakshy's study, however, with decreasing marginal returns.[52] Further my results show that for each additional female group member informed, uninformed group members are only more likely to apply for the savings opportunity.

Column (1) displays results for the grant opportunity. The first point estimate can be interpreted to mean that for each additional male informed member, if he is male, all uninformed group

[51] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.
[52] Bakshy et al., "The role of social networks in information diffusion," 523.

members are 3.5 percentage points more likely on average to apply for the grant opportunity. This is significant at the 1% level. The second point estimate is insignificant, therefore, there is not enough information to conclude that another informed member, if female, affects applications from uninformed group members for the grant opportunity. The two interaction terms measure information diffusion to females, but neither is statistically significant. From the third point estimate we cannot conclude that there is any difference in information diffusion between males and females from informed male managers. Likewise, the interaction term between female informed group members and uninformed females is insignificant and from this result we cannot conclude that there is any difference between information diffusion from informed females to uninformed females.

Column (2) displays results for the savings application. They indicate that for each additional informed male, uninformed group members are 5.4 percentage points more likely to apply for the savings opportunity on average. In contrast to the grant opportunity, for each additional female informed group member, applications from uninformed members increase by 5.5 percentage points on average for the savings opportunity. This result indicates that uninformed members in the savings opportunity benefit equally from an additional male and female informed group member on average. The estimates on the interacted terms are both insignificant, this too demonstrates that there are no statistically detectable differences in information diffusion for female group members.

To improve precision of the previous estimates, column (3) displays the results for the pooled regression. Each firm is observed twice, once for the grant application and once for the savings application, the single outcome of interest is whether they applied to either one. In the pooled sample, the only firms included are the ones that received neither the grant information nor the savings information treatment. This means that managers in this sample are not informed of either

opportunity. These results are mostly relied on to confirm findings in either the grant or savings application, rather than to inform new findings.

For these estimates to be valid, it assumes that conditions for both experiments are equal and that firms decided to apply for the opportunity independently of the other opportunity. For example, it would violate this assumption if a firm decided to apply only to the savings opportunity and not to the grant because they already applied for the savings. For uninformed firms in the treatment group there is no significant relationship between the grant application and savings application, which suggests these decisions were made independently of one another, these results are displayed in the Appendix Table A1. Results in this column confirm that male informed managers spread more information, and that informing more females is not associated with more applications from the group. Where the pooled results differ is in the interaction term between informed female group members and uninformed females, this estimate is negative and marginally significant. Which suggests that for each additional informed female group member, uninformed females are about 10.2 percentage points less likely to apply for either opportunity on average. However, this result only provides weak statistical evidence that females are negatively affected by informing more females.

In summary, my results show that in every specification an additional male informed in the group increases uninformed members' applications, these results are robust to the inclusion of the full uninformed group and controls for female group members included in the appendix Table A2 and A3.[53] My results also demonstrate that, generally, females are less likely to diffuse the same

[53] The full uninformed group included firms not in the meetings group who did not receive information, they are regarded as having 0 informed male members and 0 informed female members

information than men. As discussed, men have been found to be better at diffusing information.[54] My results are very similar to those found in Richardson et al., which showed that "male leaders had higher influence on information diffusion than females" in a studied Twitter network. They attributed their findings to female's "under-representation in leadership positions to explain their lower influence."[55] Female managers are underrepresented in my sample, and this could explain why they diffuse information less. However, in the savings application the coefficient on information diffusion between males and females are about the same, suggesting that they diffuse information at the same rate on average in that setting. Therefore, in this context, I cannot solely attribute the findings above to females' underrepresentation in the sample.

My analysis did not find robust evidence of a detectable difference in information received by females. Nor do I find that my results provide evidence of homophily, where members of the same gender communicate more with each other. In contrast, Brynjolfsson's investigation of an intrafirm network found that, "males are more likely than females to receive information of all types."[56] Their study's results also showed that gender dissimilarity between the originator and recipient had the largest negative impact on the likelihood of receiving information.[57] Likewise, Beam and Dillon found that women tended to receive information less often than men.[58] That said, there is a significant difference between our studies. Brynjolfsson and Beam studied existing networks. In

[54] Banerjee et al., "Using gossips to spread information: Theory and evidence from two randomized controlled trials," 2467; Beaman and Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," 155; Wang, Sauers, and Richardson, "A social network approach to examine K-12 educational leaders' influence on information diffusion on Twitter," 515; Brynjolfsson, and Van Alstyne, "Productivity effects of information diffusion in networks," 18.
[55] Wang, Sauers, and Richardson, "A social network approach to examine K-12 educational leaders' influence on information diffusion on Twitter," 515.
[56] Brynjolfsson, and Van Alstyne, "Productivity effects of information diffusion in networks," 17.
[57] Ibid.
[58] Beaman and Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," 155.

contrast, my study investigated information trends in randomly formed groups, comprised of members with similar social stature. Therefore, my research is a more appropriate way to study diffusion differences to women as it is not confounded by other unobserved factors that may affect information diffusion in preexisting networks.

Another aspect that may be more prevalent in pre-existing networks is trust. Perhaps, information diffusion is more likely to occur between people who trust each other. In the appendix Table A4, I include my results using Cai and Szeidl's study "trust game" data. In their study, randomly selected managers were given hypothetical trust games that they played with a random group member and a manager from a different group at midline (6 months after the first meeting) and at end line (12 months after).[59] The results show that managers are much more likely to trust members of their same group, this result is the same for females at midline. However, when they played the trust games at end line, females were more likely than men to trust their same group members. Suggesting that for females, trust between group members builds more overtime than it does for males. If trust plays a role in information diffusion, this result suggests that females are more trusting of their group members over time. If this affects females' decisions to diffuse information, then perhaps as these networks become more established females would be more likely to disseminate information. This is a topic for future research as my results show there are differences between males and females, but they are yet to be related to information diffusion.

Information Diffusion Differences between Males and Females in Competitive Groups:

The presence of competition may affect information diffusion from males and females, further it may be associated with less information received by uninformed females. Therefore, to provide

[59] Cai and Szeidl, "Interfirm Relationships and Business Performance," pg. 1270.

more details about gender differences in information diffusion, I look at how the presence of competition changes my findings. Cai and Szeidl evaluated how competition effected information diffusion. In their study, they found that the presence of competition within groups significantly decreased the strength of information diffusion by 21.1 percentage points on average for the grant application, but that this did not eliminate the effect of the information diffusion completely, they found no effect in the savings application.[60]

To test whether the strength of information diffusion decreased significantly from males and females in competitive groups, I employed equation (2), but added an interaction terms between competition and the number of male informed group members and competition and the number of female informed group members. If these terms are negative and significant, it would suggest that information diffusion significantly decreased from males and females in competitive groups.

(3) $$Applied_i = \beta_1 * Number\ of\ Male\ Group\ Members\ Informed_{Gi} + \beta_2 * Number\ of\ Female\ Group\ Members\ Informed_{Gi} + \beta_3 * Number\ of\ Males\ Group\ Members\ Informed_{Gi} * Uniformed\ Female_i + + \beta_4\ Number\ of\ Female\ Group\ Members\ Informed_{Gi} * Uniformed\ Female_i + \beta_5\ Competition + \beta_6\ Number\ of\ Male\ Group\ Members\ Informed_{Gi} * Competition_G + \beta_7\ Number\ ofFemale\ Group\ Members\ Informed_{Gi} * Competition_G + Controls + \varepsilon_i$$

In equation (3), the interpretations of β_1-β_4 remain relatively unchanged from equation (2) except they measure diffusion in uncompetitive groups. Coefficient β_5 measures the effect of competition on information diffusion for uninformed managers with neither male nor female informed

[60] Cai and Szeidl, "Interfirm Relationships and Business Performance," pg. 1267.

members. β_6 and β_7 are the coefficients of interest. β_6 measures how information diffusion is different from males in competitive groups compared to uncompetitive groups. β_7 measures how information diffusion is different from females in competitive groups. As before, a set of firm demographics are used as controls and standard errors are clustered at the group level. Results are displayed in Table IV, the principal interest in this table are the results from the competition interaction terms.

Table IV: Applications from Uninformed Managers in the Treatment Group in Presence of Competition

	(1)	(2)	(3)
VARIABLES	Grant Application	Savings Application	Pooled Application
Number of Males Informed	0.0509***	0.0504***	0.0612***
	(0.0128)	(0.00983)	(0.0106)
Number of Females Informed	0.0370	0.118***	0.0914*
	(0.0563)	(0.0355)	(0.0475)
Number of Males Informed*Females	0.00155	-0.00954	-0.00457
	(0.0144)	(0.0158)	(0.0147)
Number of Females Informed* Females	-0.0579	0.00474	-0.126**
	(0.0601)	(0.0758)	(0.0546)
Number of Males Informed* Competition	-0.0328**	0.00919	-0.00758
	(0.0158)	(0.0152)	(0.0189)
Number of Females Informed* Competition	-0.0115	-0.113**	-0.109*
	(0.0596)	(0.0454)	(0.0597)
Competition	-0.0687	-0.0111	-0.0165
	(0.0544)	(0.0768)	(0.0596)
Observations	842	831	1,030
Firm Demographic Controls	Yes	Yes	Yes

Notes: The sample is for all uninformed firms in the meetings treatment group from the midline survey data. The pooled data observes firms twice, once for the grant application and once for the savings application, the independent variable is a single indicator of whether a manager reported applying to either one. "Competition is 1 for groups in which the average number of competitors (reported by firms) is higher than the median across groups,

0 if otherwise. Firm demographics are firm size category, sector, subregion, and their interactions."[61] Robust standard errors are clustered at the group level and included in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

The results show negative and significant interaction terms between informed male group members and competition and informed female group members and competition displayed in the fifth- and sixth-point estimates. As explained above, these negative and significant interaction terms demonstrate that the presence of competition decreased information diffusion from males and females. This suggests that managers act strategically when deciding to diffuse information. However, this finding presents itself in different applications. For males, competition significantly reduces information diffusion in the grant opportunity, and not significantly in the savings opportunity nor pooled sample. For females, competition significantly decreases information diffusion in the savings application, and is found to be marginally significant in the pooled application. These results are robust to controls for female group members, sown in the Appendix Table A5.

In every column, the coefficient on number of males informed can be interpreted as the average rate of applications from uninformed members for each additional male informed in uncompetitive groups, this interpretation is the same for the number of females informed. These point estimates are consistently positive and significant at the 1% for each additional informed male group member. For each additional informed female group member the point estimate is, insignificant in the grant opportunity, positive and significant at the 1% level in the savings application, and marginally significant in the pooled sample.

Column (1) displays the results for the grant application, the 5th point estimate indicates that the strength of information diffusion decreased by 3.3 percentage points on average from male

[61] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.

informed group members in competitive groups and is significant at the 5% level. This negative coefficient almost completely negates the effect of information diffusion from males. The interaction term between informed females and competition is not significant. This is unsurprising as the point estimate on information diffusion from females is insignificant. Further, there is no heterogeneity for information received by uninformed females as indicated in the insignificant third- and fourth-point estimates.

In contrast, for the savings application displayed in column (2), the interaction term with competition was not found to be significant for informed males, but for informed females it was negative and significant at the 5% level. It suggests that females in competitive groups decrease information diffusion by 11.3 percentage points on average. This too completely negates the positive and significant effect of information diffusion from females in non-competitive groups, observed in the second point estimate. Similarly to the estimates in Column (1), there are no detectable differences in information received by uninformed females from males or females, as indicated by the third and fourth point estimates.

Column (3) demonstrates results for the pooled applications. Again, the coefficient of interest is the interaction term for male and female informed group members and competition. For females, this term is negative and marginally significant at the 10% level, which suggests that the presence of competition decreases information diffusion from each additional informed female by 10.9 percentage points on average. However, this is only marginally significant and appears to be driven by competition in the savings application.

Another finding of note in Column (3) is the negative and significant interaction term between informed female group members and uninformed females, it suggests that for each additional

informed female group members, uninformed females are 12.6 percentage points less likely to apply on average. This is significant at the 5% level. Since the large and significant interaction term between informed females and uninformed females is only present in the pooled application, it should be evaluated critically and taken only as suggestive evidence. That said, Beaman and Dillion's study found that information diffusion of a rival product was smaller in female networks than it was between males. Which could offer part of the explanation why the interaction term between informed female group members and uninformed females is significantly negative at the 5% level.[62] Further, Gneezy et al. found that women competed more with other women than they did with men.[63] If this is the case here perhaps informed females are less willing to share information with other women, and that this may be heightened in the presence of competition.

These results are interesting because they suggest that the behavior of male and female informed group members differs in the presence of competition, but that females react more to competition than men. An explanation for this result could be that females are more sensitive to competition than males. Since the grant application itself is seen to be "rival," females may be unwilling to share information in any group setting, which is why there is not a positive and significant point estimate on female information diffusion displayed in Table III or IV. In the savings application, the female information diffusion point estimate in both Table III and Table IV is positive and significant, but there is a negative and significant point estimate on the interaction term between females informed and competition in Table IV. This shows that females do spread information about the savings opportunity, but it is significantly reduced in competitive groups. This gives

[62] Beaman and Dillon, "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali," 155.
[63] Gneezy, Niederle, and Rustichini, "Performance in competitive environments: Gender differences," 1061.

some evidence that, on average, females react more to competition, whether that be not sharing rival information at all or sharing less rival information in competitive group settings.

Some studies have documented that females and males behave differently in competitive environments.[64] The seminal study of Gneezy et al. demonstrated that women display less of a competitive boost in performance than men when asked to compete and that the performance gap is widened when they compete against men.[65] Gupta et al.'s related research found that women were less likely to choose a competitive payment scheme than men.[66] Taken together, these results demonstrate possible reasons for the findings above. Females in this sample may aim to compete less by informing less people, as the results show for the grant opportunity and in competitive groups for the savings opportunity. The negative and marginally significant interaction term between females and competition in the pooled sample, demonstrates too, in general, females may be more averse to competition than men and adjust their behavior accordingly.

Peer Effects between Informed Group Members:

Another important aspect is whether the caliber of applications was different from males or females, or in competitive and uncompetitive groups. A way to test this would be to determine if there are any differences in application awards to different types of groups or differences between males and females. There was only data available for firms who were awarded the government

[64] Nabanita Datta Gupta, Anders Poulsen, and Marie Claire Villeval, "Male and female competitive behavior-experimental evidence," *GATE Working Paper* No. W.P.05-12 (Nov. 2005), 1;
Gneezy, Niederle, and Rustichini, "Performance in competitive environments: Gender differences,"1049;
c.f Alison Booth, and Patrick Nolen, "Choosing to compete: How different are girls and boys?," *Journal of Economic Behavior & Organization* Vol.81, No. 2 (Feb. 2012): 542.
[65] Gneezy, Niederle, and Rustichini, "Performance in competitive environments: Gender differences," 1049.
[66] Gupta, Poulsen, and Villeval, "Male and female competitive behavior-experimental evidence," 2.

grant. So, to evaluate this, I used the following specification based on Cai and Szeidl's information diffusion measure in their paper:[67]

(4) $$Grant\ Awarded_i = \gamma_1 * Group\ Member\ Informed_i + \gamma_2 * Group\ Member\ Informed_i * Female_i + \gamma_3 * Competition_i + \gamma_4 * Competiton_i * Female_i + \gamma_5 * Competition_i * Group\ Member\ Informed_i + \gamma_6 * Competiton_i * Group\ Member\ Informed_i * Female_i + Controls + \varepsilon_{it}$$

Where the dependent variable is an indicator for whether the uninformed manager *i* received the grant product. Coefficient γ_1 measures the association between having informed group members and being awarded the grant, γ_2 measures whether this is different for female managed firms. γ_3 measures whether competition is associated with different grant awards. γ_4 measures whether the presence of competition is different for females in the meetings groups, γ_5 measures whether having informed group members and being in a competitive group changed grant award and γ_6 measures whether this effect was different for uninformed females in with informed group members in competitive groups. ε_i is the error term.

[67] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1265.

Table V: Grant Awarded to Uninformed Firms in the Meeting Treatment Group

VARIABLES	(1) Grant Awarded
Having Informed Group Members	0.0522**
	(0.0236)
Having Informed Group Members* Female	0.00949
	(0.0509)
Competition	-0.0223
	(0.0205)
Competition* Female	-0.00377
	(0.0125)
Having informed Group Members* Competition	-0.0306
	(0.0287)
Having informed Group Members* Competition*Female	0.00770
	(0.0570)
Firm Demographic Controls	Yes
Observations	842

Notes: The sample is for all uninformed firms in the meetings treatment group from the midline survey data. "Competition is 1 for groups for groups in which the average number of competitors (reported by firms) is higher than the median across groups, 0 if otherwise. Firm demographics are firm size category, sector, subregion, and their interactions."[68] Robust standard errors are clustered at the group level and included in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

There are no significant differences in grant awards to uninformed female managers, nor competitive groups. This indicates that female managed firms and competitive groups were not associated with a different caliber of application than those in uncompetitive groups with an informed group member. This provides some indication that there is a lack of peer effects, as it does not appear that applications are stronger from different types of groups or gender. This finding

[68] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.

relates to my final specification discussed below. The results also indicate that having an informed group member increases the chances of being awarded the grant by 5.2 percentage points on average for uninformed group members, but this can be attributed to their increased awareness of the grant opportunity.

The results above show that uninformed managers do not have stronger or weaker applications from different types of groups, which suggests that there aren't peer effects. Related to this is whether more informed male or female group members changes applications from informed group members. This analysis will be developed further by evaluating the effect on applications for informed group members when an additional group member of their same gender is also informed.

The hypothesis is that as more of the same gender group members get informed, evidence of homophily emerges in which members of the same gender encourage each other to apply for either opportunity. To evaluate this, I employed equation (2), but restricted the sample to informed group members and employed interaction terms to members of the same gender. To determine the number of female and male group members as the number of group members informed not counting the individual themselves. For example, in a group that has two informed female group members and two informed male group members, the informed female *i* has one other female group member informed and two other male group members informed. Results are displayed in Table VI.

Table VI: Applications from Informed Managers in the Meetings Treatment Group

	(1)	(2)	(3)
Independent Variable	Grant Application	Savings Application	Pooled
Number of Other Male informed Group Members	-0.00400	0.00807	-0.0267
	(0.0198)	(0.0125)	(0.0280)
Number of Other Female Informed Group Members	0.0297	0.0154	0.0231
	(0.0320)	(0.0198)	(0.0321)
	0.000405	-0.00366	0.0245
Number of Other Female informed Group Members* Female	(0.0160)	(0.00794)	(0.0198)
	-0.0421	0.0184	0.0300
Number of Other Male informed Group Members* Males	(0.102)	(0.0776)	-0.0267
Firm Demographic Controls	Yes	Yes	Yes
Observations	563	574	494

Notes: The sample is for all informed firms in the meetings treatment group from the midline survey data. The pooled data observes firms twice, once for the grant application and once for the savings application, the independent variable is a single indicator of whether a manager reported applying to either one. Firm demographics are firm size category, sector, subregion, and their interactions."[69] Robust standard errors are clustered at the group level and included in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

The results above show that group member application decisions are not contingent on additional informed group members becoming informed. These results are the same for competitive and uncompetitive groups. Since results are not changed in competitive groups there is no evidence of "structural equivalence" in which group members "closely follow each other […] so as to not lose their competitive advantages."[70] Further, they show that there is no evidence of homophily in which members encouraged others of the same gender encourage others to apply.

[69] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.
[70] Hang Xiong, Diane Payne, and Stephen Kinsella, "Peer effects in the diffusion of innovations: Theory and simulation," 5.

Similarly, Banerjee et al. discusses the lack of an "endorsement effect" where, "once a household is informed, its decision to participate is not affected significantly by its neighbor's decision to participate."[71] My results are in alignment with this finding, as informed group managers' applications are not affected by an additional group member becoming informed. Therefore, once a manager is informed their decision to apply is evidenced to be driven by the relevance of the information to the manager themselves. However, since managers can only weigh the general cost-benefit of the information they received and not their peer's experiences, perhaps observed here is the sole effect of the information itself, and peer's influence on applications could only be observed later.[72]

[71] Banerjee et al., "The diffusion of microfinance," 370.
[72] Hang Xiong, Diane Payne, and Stephen Kinsella, "Peer effects in the diffusion of innovations: Theory and simulation," 4.

IV Conclusion

My results show that on average men tend to diffuse information more than woman, and that part of these differences can be ascribed to how female managers react to competition. I do not find robust evidence that uninformed females receive less information than males. Further, I do not find evidence of peer effects, peers do not seem to affect the caliber of application nor an informed group member's decision to apply.

While these results are informative, their limitations warrant discussion. This experiment took place in China, which may have very different gender roles from other countries. Further, it relies on survey data, it could be the case that managers who were not awarded the grant or savings opportunity were dishonest and said they did not apply and that this bias is different for females than it is for males. Further, information diffusion is measured by actions, not if managers heard the information but decided not to act on it. This could bias downwards estimates and may be different if managers receive information from males or females. That said, these results provide credible evidence on male's and female's diffusion strategies and how they change in the presence of competition in randomly formed networks.

My results demonstrate that structural disadvantages towards women found in other studies on pre-existing networks are not present in these results. This suggests that these trends are not entrenched into newly formed networks and that females in a majority male context are not at a disadvantage for receiving information, a finding which may put into question certain established policy approaches to gender equality. That said, randomly forming networks with individuals of a similar caliber is not a particularly actionable policy recommendation. However, the value of randomly formed networks and committees is surprisingly high.

A simple interpretation of these results is that it is better to inform men if you want information to be spread. However, such an approach would ignore the possible root cause of the findings. A larger, perhaps more pertinent structural problem displayed in these results is that in a majority male setting, females are more sensitive to competition than males, and this may disproportionality harm other women. This is an important finding and provides insight into the differences in how males and females behave. It is not, therefore, my policy recommendation to exclude women from the information diffusion process. If information diffusion is used for policy, it should be reserved for communicating non-rival information. If rival information is to be communicated, then broadcasting it would better ensure against information hoarding. Structural differences between males and females should be addressed by designing more interventions to evaluate differences in competitive environments and bid to bridge the gap between their differing behavior so that getting ahead can really be about what you know. Until then, as it is now, it is clear who you know dictates what you know at least as it pertains to information diffusion.

Appendix

Relationship between the Savings and Grant Application:

Table A 1: Relationship between Savings and Grant Application

VARIABLES	(1) Grant Application	(2) Grant Application
Savings Application	-0.0199	0.0201
	(0.0415)	(0.0396)
Firm Demographics	Yes	No
Observations	519	519

Notes: This table uses Cai and Szeidl's midline survey data. The sample includes firms uninformed of either the grant or savings opportunity in the data. Firm demographics are firm size category, sector, subregion, and their interactions."[73] Robust standard errors are clustered at the group level and included in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

[73] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.

Applications for the full Uninformed Sample:

Table A 2: Applications for the Full Uninformed Sample

VARIABLES	(1) Grant Application	(2) Savings Application	(3) Pooled Application
Number of Males Informed	0.0509***	0.0504***	0.0612***
	(0.0128)	(0.00983)	(0.0106)
Number of Females Informed	0.0370	0.118***	0.0914*
	(0.0563)	(0.0355)	(0.0475)
Number of Males Informed*Females	0.00155	-0.00954	-0.00457
	(0.0144)	(0.0158)	(0.0147)
Number of Females Informed* Females	-0.0579	0.00474	-0.126**
	(0.0601)	(0.0758)	(0.0546)
Number of Males Informed* Competition	-0.0328**	0.00919	-0.00758
	(0.0158)	(0.0152)	(0.0189)
Number of Females Informed* Competition	-0.0115	-0.113**	-0.109*
	(0.0596)	(0.0454)	(0.0597)
Competition	-0.0687	-0.0111	-0.0165
	(0.0544)	(0.0768)	(0.0596)
Observations	842	831	1,030
Firm Demographic Controls	Yes	Yes	Yes

Notes: This table uses Cai and Szeidl's midline survey data. The sample includes all firms in the uninformed firms in the data. The pooled data observes firms twice, once for the grant application and once for the savings application, the independent variable is a single indicator of whether a manager reported applying to either one. Firm demographics are firm size category, sector, subregion, and their interactions."[74] Robust standard errors are clustered at the group level and included in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

[74] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.

Table A 3: Applications from Uninformed in Treatment with Female Group Member Controls

Independent Variable	Grant Application	Savings Application	Pooled Application
Number of Male informed Group Members	0.0327***	0.0541***	0.0680***
	(0.0104)	(0.00787)	(0.00822)
Number of Female Informed Group Members	0.0526	0.0526*	0.0140
	(0.0465)	(0.0275)	(0.0361)
Number of Male informed Group Members* Female	-0.00124	-0.00645	-0.0107
	(0.0153)	(0.0165)	(0.0142)
Number of Female informed Group Members* Female	-0.0534	0.00156	-0.103**
	(0.0604)	(0.0768)	(0.0521)
Female Group Members	-0.0211	0.00394	0.0195
	(0.0272)	(0.0172)	(0.0143)
Observations	842	831	1,938
Firm Demographic Controls	Yes	Yes	Yes

Notes: This table uses Cai and Szeidl's midline survey data. The sample includes all firms in the uninformed firms in the data. The pooled data observes firms twice, once for the grant application and once for the savings application, the independent variable is a single indicator of whether a manager reported applying to either one. Firm demographics are firm size category, sector, subregion, and their interactions."[75] Robust standard errors are clustered at the group level and included in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

[75] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.

Hypothetical Trust Game Results:

Table A 4: Hypothetical Trust Game between Members in the Same Group vs. Members in Another Group

VARIABLES	Choice in Trust Game
Regular Meetings*Midline	1.341***
	(0.162)
Regular Meetings*End line	2.031***
	(0.329)
Regular Meetings*Midline*Female	0.242
	(0.387)
Regular Meetings*End line*Female	1.447**
	(0.633)
Peer Demographics	Yes
Firm FE	Yes
Observations	1,335

Notes: Results are presented for a hypothetical trust game within regular meetings groups and across meetings groups for firms who participated in the regular and cross group meeting at midline and end line. "Peer demographics are the share of peers in the given group which are larger than the subregion median (measured with employment at baseline) and the share of peers in the given group that are in the same sector as the firm. Standard errors in parentheses. ***p < .01, **p < .05, *p < .1."[76]

$$Relation = const + \theta_1 * Mideline_{igt} * Regular_{igt} + \theta_2 * Endline_{igt} * Regular_{igt} + \theta_3 * Mideline_{igt} * Regular_{igt} * Female + \theta_4 * Endline_{igt} * Regular_{igt} * Female + Controls + Firm\ F.E. + \varepsilon_{igt}$$

"Here each observation is a firm, group category (regular or cross), and year triple. The sample consists of observations in the mid- line and endline waves for the set of firms that participated in both regular and cross-group meetings. The dependent variable is a measure of relationships between firm *i* and peers in group g in year t, such as the number of active partners from the group in that year. The coefficients of interest are θ_3 and θ_4 , which measure the extent to which female firms had more relationships with peers in the regular group. Column (3) reports average giving in hypothetical trust games played with a randomly chosen member of the regular group and of the cross group."[77]

[76] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1269.
[77] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1269.

Competition Results with Female Group Member Controls:

Table A 5: Applications from Uninformed in Treatment in the Presence of Competition and Female Group Members

	(1)	(2)	(3)
VARIABLES	Grant Application	Savings Application	Pooled Application
Number of Males Informed	0.0499***	0.0507***	0.0606***
	(0.0134)	(0.00978)	(0.0107)
Number of Females Informed	0.0464	0.117***	0.0950*
	(0.0623)	(0.0386)	(0.0503)
Number of Males Informed*Females	0.00350	-0.00985	-0.00356
	(0.0154)	(0.0161)	(0.0153)
Number of Females Informed* Females	-0.0574	0.00444	-0.125**
	(0.0602)	(0.0760)	(0.0539)
Number of Males Informed* Competition	-0.0331**	0.00911	-0.00767
	(0.0158)	(0.0151)	(0.0190)
Number of Females Informed* Competition	-0.0109	-0.112**	-0.108*
	(0.0592)	(0.0456)	(0.0597)
Competition	-0.0653	0.0492	-0.0156
	(0.0544)	(0.0495)	(0.0603)
Female Group Members	-0.0115	0.00198	-0.00709
	(0.0233)	(0.0168)	(0.0195)
Observations	842	831	1,030
Firm Demographic Controls	Yes	Yes	Yes

Notes: The sample is for all uninformed firms in the meetings treatment group from the midline survey data. The pooled data observes firms twice, once for the grant application and once for the savings application, the independent variable is a single indicator of whether a manager reported applying to either one. "Competition is 1 for groups in which the average number of competitors (reported by firms) is higher than the median across groups,

0 if otherwise. Firm demographics are firm size category, sector, subregion, and their interactions."[78] Robust standard errors are clustered at the group level and included in the parentheses. *** p<0.01, ** p<0.05, * p<0.1

[78] Cai and Szeidl, "Interfirm Relationships and Business Performance," 1266.

Bibliography

Aral, Sinan, Erik Brynjolfsson, and Marshall W. Van Alstyne. "Productivity effects of information diffusion in networks." *MIT Sloan School Working Paper,* 4683-08, (2007): 1-44.

Bakshy, Eytan, Itamar Rosenn, Cameron Marlow, and Lada Adamic. "The role of social networks in information diffusion." In *Proceedings of the 21st international conference on World Wide Web*, pp. 519-528. 2012.

Banerjee, Abhijit, Arun G. Chandrasekhar, Esther Duflo, and Matthew O. Jackson. "The diffusion of microfinance." *Science* 341, no. 6144 (2013): 363-370.

Banerjee, Abhijit, Arun G. Chandrasekhar, Esther Duflo, and Matthew O. Jackson. "Using gossips to spread information: Theory and evidence from two randomized controlled trials." *The Review of Economic Studies* 86, no. 6 (2019): 2453-2490.

Banerjee, Abhijit, Emily Breza, Arun G. Chandrasekhar, Esther Duflo, and Matthew O. Jackson. "Come play with me: Experimental evidence of information diffusion about rival goods." *Working Paper,* (August 2012): 1-34.

Banerjee, Abhijit, Emily Breza, Arun G. Chandrasekhar, and Benjamin Golub. “When less is more: Experimental evidence on information delivery during India's demonetization.” *National Bureau of Economic Research*, No. w24679 (2018): 1-79.

Banerjee, Abhijit, Esther Duflo, Rachel Glennerster, and Cynthia Kinnan. "The miracle of microfinance? Evidence from a randomized evaluation." *American economic journal: Applied economics* 7, no. 1 (2015): 22-53.

Bardasi, Elena, Shwetlena Sabarwal, and Katherine Terrell. "How do female entrepreneurs

perform? Evidence from three developing regions." *Small Business Economics* 37, no. 4 (2011): 417-441.

Beaman, Lori, and Andrew Dillon. "Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali." *Journal of Development Economics* 133 (2018): 147-161.

Bertrand, Marianne, Sandra E. Black, Sissel Jensen, and Adriana Lleras-Muney. "Breaking the glass ceiling? The effect of board quotas on female labour market outcomes in Norway." *The Review of Economic Studies* 86, no. 1 (2019): 191-239.

Booth, Alison, and Patrick Nolen. "Choosing to compete: How different are girls and boys?." *Journal of Economic Behavior & Organization* 81, no. 2 (2012): 542-555.

Cai, Jing, and Adam Szeidl. "Interfirm relationships and business performance." *The Quarterly Journal of Economics* 133, no. 3 (2018): 1229-1282.

Cai, Jing, and Adam Szeidl. “Indirect effects of access to finance.” *National Bureau of Economic Research* no. w29813. (2022): 1-74.

Cai, Jing; Szeidl, Adam. *Replication Data for:'Interfirm Relationships and Business Performance'*. V1. December 08, 2017. Distributed by Harvard Dataverse. https://doi.org/10.7910/DVN/5ZX8ZI.

Datta Gupta, Nabanita, Anders Poulsen, and Marie Claire Villeval. "Male and female competitive behavior-experimental evidence." *GATE Working Paper* No. W.P.05-12 (2005), 1-38.

Gneezy, Uri, Muriel Niederle, and Aldo Rustichini. "Performance in competitive environments: Gender differences." *The quarterly journal of economics* 118, no. 3 (2003): 1049-1074.

Goldin, Claudia, and Cecilia Rouse. "Orchestrating impartiality: The impact of" blind" auditions

on female musicians." *American economic review* 90, no. 4 (2000): 715-741.

Hardy, Morgan, and Jamie McCasland. "It takes two: experimental evidence on the determinants of technology diffusion." *Unpublished paper, University of British Columbia* (2016).

Immorlica, Nicole, Brendan Lucier, and Evan Sadler. “Sharing rival information.” *Working paper* (2014)1-20.

Islam, Asif, Isis Gaddis, Amparo Palacios-Lopez, and Mohammad Amin. "The labor productivity gap between female and male-managed firms in the formal private sector." *World Bank Policy Research Working Paper* 8445 (2018).

Kitsak, Maksim, Lazaros K. Gallos, Shlomo Havlin, Fredrik Liljeros, Lev Muchnik, H. Eugene Stanley, and Hernán A. Makse. "Identification of influential spreaders in complex networks." *Nature physics* 6, no. 11 (2010): 888-893.

Lalanne, Marie, and Paul Seabright. "The old boy network: Gender differences in the impact of social networks on remuneration in top executive jobs." *CEPR Discussion Paper*, No. DP8623 (2011): 1-51.

Loury, Linda Datcher. "Some contacts are more equal than others: Informal networks, job tenure, and wages." *Journal of Labor Economics* 24, no. 2 (2006): 299-318.

McKenzie, David, and Susana Puerto. "Growing markets through business training for female entrepreneurs: A market-level randomized experiment in Kenya." *American Economic Journal: Applied Economics* 13, no. 2 (2021): 297-332.

Quisumbing, Agnes R., and Neha Kumar. "Does social capital build women's assets? The long-term impacts of group-based and individual dissemination of agricultural technology in Bangladesh." *Journal of Development Effectiveness* 3, no. 2 (2011): 220-242.

Rogers, Everett M. *Diffusion of innovations*. Simon and Schuster, 2010.

Stein, Jeremy C. "Conversations among competitors." *American Economic Review* 98, no. 5 (2008): 2150-62.

Wang, Yinying, Nicholas J. Sauers, and Jayson W. Richardson. "A social network approach to examine K-12 educational leaders' influence on information diffusion on Twitter." *Journal of School Leadership* 26, no. 3 (2016): 495-522.

Xiong, Hang, Diane Payne, and Stephen Kinsella. "Peer effects in the diffusion of innovations: Theory and simulation." *Journal of behavioral and Experimental Economics* 63 (2016): 1-13.