Herding behavior inside the board: an experimental approach

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Abstract

An experimental study was made to measure the impact of “herding behavior” inside a board of directors based on the González (2002) theoretical model which maintains that in a board meeting composed of a CEO and two external directors (A and B), where voting is sequential (CEO®A®B) and the directors’ reputation is valuable, director B tends to copy director’s A decision. Based on the observations taken from the experiment, director B ignores his own information (signal) in 63.37 percent of the studied cases, presumably copying director A’s vote, thus, confirming the presence of herding behavior. Furthermore, the econometric analysis shows that director’s A voting has a positive influence on director’s B voting, and that director’s B signal has a negative influence on his own voting. Thus, confirming again the presence of herding behavior.
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Introduction

"Herding behavior" or herding occurs when an individual takes a decision imitating another's actions and ignoring his or her own information, even though his or her private information suggests something different. Additionally, individuals who perceive themselves as lacking sufficient information in complex and uncertain situations can observe others' actions that, presumably, are better informed; in consequence, the insecure individuals disregard their own information and follow other's actions (Bainbridge, 2001).

Boards of directors are stockholders' agents, and therefore, their main responsibility is to monitor and discipline management. In theory, board independence is considered a direct consequence of the number of external directors; the more independent, the better their management oversight. Nevertheless, studies regarding the matter have not been conclusive. The empirical evidence seems to show that the incorporation of new directors does not have an impact on firms' performance (Bhagat and Black, 2000). A possible cause, and the focus of our study, is that, disagreements seldom exist due to the small size of boards, and their well-appraised civic mindedness and consensus preference (Bainbridge, 2001). This happens because external directors tend to follow a leader, disregarding their own information.

To measure the impact of this phenomenon in board meetings, an experimental study was done based on the González (2002) theoretical model. This model maintains that in a board composed of a CEO and two external directors (A and B), where the voting is sequential and their reputation worthy, director B tends to copy director A's decision.

To perform the experiment, eight group sessions with two groups where held, each composed of three participants: the CEO called the Grey participant, "director A" called the Blue participant, and "director B" called the White participant.

Each group had to approve or reject thirty projects that could have been successful (NPV>0) or unsuccessful (NPV<0), each with a fifty percent probability. The Grey participant (or CEO) knew the true quality of the project; The Blue participant (director A) and the White participant (director B) received a signal regarding the quality of the project, which could be correct or incorrect, according to each director's competence, which was determined previously at random.

Each participant had to approve or reject the project according to the information mentioned earlier and based on an individual compensation scheme. Each participant's profit was determined according to his or her individual compensation table and according to the number of correct decisions taken by the whole group during the session (approval of NPV>0 projects and rejections of NPV<0 projects).

When studying 273 observations in which A's voting and B's signal were contradictory regarding the project's quality, it was found that in 63.37 percent of the cases director “B” (White Participant) ruled out his own information, presumably copying director's "A" decision (Blue Participant). Later on in the paper, an econometric Logit model confirmed this result; that is, we find evidence of herding behavior in the experiment.

While these results cannot be considered conclusive to determine the behavior of the board of directors due to the obvious limitations in our experimental setting, these results could be taken as preliminary evidence of herding behavior in a board's decision-making dynamics; that is, some directors tend to ignore his or her private information (signals) and simply follow an opinion leader on the board.

The problem

Previous research on boards of directors, especially when studied as a control mechanism to reduce agency costs between managers and owners, seems to indicate that the incorporation of external (or independent) directors has no impact on firm performance (Bhagat and Black, 2002). Contrary to popular belief and the arguments of many researchers, the empirical evidence seems to indicate that external directors do not improve the monitoring role of the board. A possible cause for these findings could be the difficulty to isolate and measure the specific impact of the board of direc-
tors in the firm’s performance. Another possible explanation is that the decision-making dynamics of a board of directors limits the contribution that external directors might provide. Some authors believe that in small groups, with a high degree of civic-mindedness (such as boards of directors), consensus is more valued than the realistic evaluation of alternatives (Jensen, 2000; Bainbrige, 2001). The possibility of sanctions (implicit or explicit) within the group could dissuade external directors from presenting a strong adverse position to other members of the board. When we add to these implicit (e.g. not being invited to sit on other boards) or explicit (e.g. getting fired from the board) costs, along with the natural lack of detailed information that the directors usually have available before making a decision, it is easy to understand the minor impact that these directors have on a firm’s performance.

Additionally, although it has been demonstrated that reputation is valuable to directors, when decisions are collectively taken, it is difficult to externally evaluate each individual’s impact in the final result. For this reason, free riding, or parasitism, is possible, which occurs when some individuals take advantage of the other’s information without going through the efforts of acquiring it by themselves. Since boards of directors are small groups, in which disagreements are rarely presented, and civic-mindedness and consensus are highly appreciated, some researchers claim that herding behavior is likely to occur. This behavior takes place because external directors tend to follow a leader, ignoring their own information. This could also be one of the reasons why the incorporation of external directors does not affect the company’s performance.

The objective of this paper is to determine, via an experimental study, if conditions exist inside the board of directors to generate herding behavior among its members, that is, directors ignoring their own information when making decisions and, instead, following a leader.

The study of herding behavior in the board of directors is a very important issue because it affects the core of one fundamental corporate governance paradigm: Outside directors are considered to be better monitors than inside directors. This will not be true if outside directors tend to herd. In this manner, we attempt to create an experimental study imitating the hypothetical dynamics of decision-making in a fictitious board of directors. In spite of the logical limitations that come from representing reality in the “laboratory”, this study will shed light on how herding behavior influences the decision-making process of boards of directors.

Therefore, the results of this study can help improve some aspects of corporate governance by: 1) understanding the institutional and personal mechanisms responsible for the herding behavior in boards of directors; 2) forecasting when herding behavior is more likely; and 3) designing public and private regulations, as well as incentive mechanisms, to diminish the herding behavior and its consequences in the board.

**Literature review and hypothesis**

Banerjee (1992) shows theoretically that individuals wanting to optimize their wealth could make decisions that are characterized by “herding behavior”; in other words, in some cases individuals will do what others do, instead of using their own information to make decisions. Therefore, the resulting equilibrium is inefficient because the input of the individual that herds is lost.

González (2002) claims that under normal circumstances there is a tendency by independent directors to follow a leader, consequently acting under the herding behavior. He argues that this is inefficient because by excluding the information contained in those directors’ signals, this information is lost. In the theoretical model he develops there is a board of directors with a CEO (who al-
ways wants to approve the project) and two independent directors, A and B, who must approve or reject a project. The independent directors receive signals on the quality of the project, which could be correct or incorrect depending on each director's competences. Nobody knows the directors' true competence (even the directors themselves); however, everybody knows the prior probability of competence (common knowledge).

One consequence of this theoretical setting is that the market updates the probability of competence (Bayesian update) by observing whether the board of director's decision was unanimous or divided and whether the project turned out to be successful or unsuccessful. If the board approves the project, but one of the directors votes against it (divided decision), then the market will know that one of the directors is incompetent²; the market then observes the output of the project: if the project was approved and it turned out to be successful, the director that rejected it is punished in terms of reducing the market assessment of his or her competence³. Alternatively, if the project turns out to be unsuccessful, then the director that rejected it is awarded a better assessment of his or her competence. If the market observes a unanimous decision, the prior probabilities of competences of the directors are not updated.

There are three stages in this process: (1) the manager proposes a project; (2) each independent director receives a signal; (3) the directors vote, one after the other, approving or rejecting the project; and, (4) the results of the decisions are acknowledged and the market reevaluates each director's competence. Under these assumptions, the model shows that when reputation is valuable (directors care about the Bayesian update that the market does after the decision is made), the second independent director (director B) will always copy the predecessor's vote, regardless of his or her signal; that is, he is herding. This is a conjecture as to why a positive relationship between the incorporation of independent directors and the subsequent company's performance has not been found conclusively (Bhagat and Black, 2000).

Additionally, the experimental investigation has shown that when making decisions in small and cohesive groups with very strong cooperation rules and civic-mindedness, consensus is more valued than a realistic evaluation of the alternatives (Bainbridge, 2001). Therefore, even though there is evidence in psychology and experimental economy (Shaw, 1932; Blinder and Morgan, 2000) of group decisions beating the best individual in a sample, perhaps it is because it also tends to overcome the limits of individual rationality. It is also true that groups, such as boards of directors, emphasize politeness over supervision (Jensen, 2000).

Nevertheless, Warther (1998) claims that the board of directors moves between the extremes of passivity and action. He shows, through a theoretical model, that even though we should not expect a constant debate inside the board of directors because its structure is not appropriate for this, the board does fulfill an important disciplinary role in replacing the company's CEO in some cases.

Several research papers study the voting dynamics; some of them specifically focus on the decision-making processes of committees or groups (Cohen et al., 1978; Hoffman and Plott, 1983; Dekel and Piccione, 2000; Gillette, et al, 2003). The last two papers are of great interest in our study. The first (Dekel and Piccione, 2000), contains results of voting experiments on committees in which a fixed agenda determined a sequence of binary decisions. The results depend on a myopic or a strategic voting model. Initially, the subjects voted according to myopic rules; and the strategic voting occurred after some experience was accumulated. The use of the same preferences, seen in later meetings, had more influence in the strategic voting than the distribution of public information of the number of voters and their pre-

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² In the theoretical model, it is assumed that if both directors receive the same signal and both are competent, then both will make the same decision; therefore, when the market observed a divided decision, it is sure that one of the two directors is incompetent; however, the market cannot tell with certainty which director is the incompetent one.

³ The market can not tell for sure that the director that rejected the project is incompetent because in the model signals are not perfectly correlated with the project quality; the model's only assumption in this regard is that if a competent director receives a good signal about the quality of the project, then the probability that the project turns out successful is greater than if the signal was bad.
ferences. The second, (Gillette, et al, 2003) examines the votes by a designated committee, which mitigates the conflicts of interest between internal agents with privileged information and the shareholders. As the investigations and business press affirm, and the model demonstrates, in a board with a leading majority of uninformed external independent and reliable directors (watchmen or watchdogs), favorable policies can be implemented for a company. The model emphasizes the necessity of penalizing the internal directors when there is discord between the members of a meeting. Nevertheless, the penalty for dissention seems to have a low impact on the experimental results. In both papers, sequential voting was used, even though it has been stated in many cases that sequential voting does not add more information than simultaneous voting (Dekel and Piccione, 2000). Also, cash money was used as incentive for the participating subjects. However, it must be noted that in some studies regarding the design of incentives and their influence in the decision making process, it is affirmed that these are not determining factors in all cases (Davis and Holt, 1999). Money is perhaps the best measurement because, among other reasons, it allows measurement of the losses or the lack of maximization on the subjects' part, which are usually considered weaknesses in the model (Fudenberg and Levine, 1997). On the other hand, the usual practice is to use numerous game rounds, approximately between eight and ten, although it is possible to use experimental models with single-round games (Goeree and Holt, 2001).

In this paper, we intend to demonstrate, for the approval of an investment project, the following hypothesis:

In a board of directors composed of a CEO that always votes in favor of a project, and two independent outside directors (A and B), there will be a "leader", external director (director A) who will vote according to his or her own signals, and there will be a "follower", external director (director B), that will herd on the vote of the director A, without considering his own private information.

### Design of the herding experiment

**A. Objective**

As indicated before, the aim of this study is to model the behavior of the board of directors with one CEO and two external directors who have to approve or reject a project. The CEO knows the quality of the project and the external directors receive a signal on the quality, which could be correct or incorrect. This signal will depend on the director's competence. The objective is to verify in a sequential voting (CEO ® director A ® director B) whether director B tends to herd on director A's decisions, ignoring his own signals.

**B. Characteristics**

Table I shows the most relevant practical characteristics of the experiment

**C. Justification**

1. **Members of the group**

A group of three people adjusts to the González (2002)'s model and is easier to control, given the difficulty of working with groups, such as delays, absences, parallel conversations, etc. Additionally, costs are reduced substantially, making it easier to find the required number of participants.

2. **Number of groups**

Despite of the apparent relation between the number of participants and the difficulty of the experiment, it was decided to make the experiment using two groups in each session. The decision was based on observation of the participants' behavior in some preliminary rounds of testing. There was an evident tendency to decide without much thought, since the perspective of making money without difficulty generates a "casino effect". This is contrary to what we would expect from the member of a real board. Thus, to control the "casino effect" in the experiment we set the two groups in each session to compete among each other. The group with the greatest number of successes (acceptance of NPV > 0 projects and rejection of NPV < 0 projects) was considered the winner of
the session, and their members would keep all the money they had been accumulating during the experiment, whereas the members of the loosing group would only keep half of the money they collected.

3. **Number of sessions and rounds**:
The number of sessions was chosen by taking several factors into consideration. First, we needed to have the greatest number of observations to obtain accurate results, considering that the relevant observations are those in which the signals of the outside directors were different (see below). The second factor we considered was the economic resources per participant in the experiment. Concerning the number of rounds, two factors were also taken into account: First of all, getting the greatest number of possible observations in each session, and secondly, the quality of each one. Evidently, the quality of the sessions diminishes as the number of rounds increases. Thus, the number of rounds was established at thirty, with five or six preliminary rounds for practice (these observations were not considered in the study) to familiarize the volunteers with the experiment.

**D. Design of the experiment**
For each session two groups were formed; each with three participants, identified as: “Gray”, “Blue”, and “White”. In terms of the González (2002) model, they represent the CEO, director A and director B, respectively. The allocation of the group and type of participant were chosen at random. The project was approved if two or more members voted in favor. The participants of each group received a compensation, which depended on each individual's compensation table (see below) and the quality of the decision taken by the group (correct or incorrect) compared to the other group in the session.

**E. Information**

1. **Quality of the Project**
The project considered by the group could be high quality (NPV > 0) or low quality (NPV < 0), each with a 50 percent probability. The true quality of the project is determined at the beginning of each round, when the Gray participant picks a chip at random out of a bag that contains five red chips (NPV < 0) and five blue chips (NPV > 0). If the chip is red, the project is low quality and if the chip is blue, the project is high quality. The color of the chip is only observable by the Gray participant and by the experiment's coordinators.

2. **Signals**
Each external director (Blue and White participants) receives a signal on the quality of the project (Good or Bad). This signal could be correct or incorrect depending on the directors' competences. The competence of the Blue and White participant (or director A and B respectively) was chosen at random for each round. The competent player always gets the right signal (good signal if the NPV > 0 and bad signal when the NPV < 0) and the incompetent player always gets the wrong signal. Following the González (2002) model, directors are never sure of the relative competence for a given decision.

3. **Competences**
The Blue and White participants’ competence is determined, for each round, when they select a number from one to ten, for which five numbers represent competence and the other five numbers represent incompetence. The numbers corresponding to each category (competence or incompetence) are assigned at random for each round. The following information was available to each participant:
- The Gray participant observes his table of incentives (see below) and knows the project’s true quality.
- The Blue participant observes his table of incentives (see below), the Gray participant’s vote (to accept or reject the project) and his own signal.

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4 The participants did not know what role they would play in the González (2002) model; in fact, they did not know that a theoretical model existed for this experiment.
• The White participant observes his table of incentives (see below), the Gray and Blue participants' votes, and his own signal.

Given the information for each participant, the voting order is rigid: Gray votes first (CEO), Blue (director A) votes second and White (director B) votes last. The whole process of voting is done out loud.

F. Individual compensation

Table II shows the individual compensation table for each participant.

The numbers in the table represent the profits and losses in local currency (to find the dollar equivalent divide the amount by 1,600 Bs/ $ (exchange rate of the time of the experiment), where Bs. signifies “bolivars”-Venezuelan currency). For example, suppose participant Gray knows that the project will be successful (NPV >0). As shown in Panel A, in this case the project must be approved to obtain the Bs. 1,000 profit, if not he or she will lose Bs. 3,000. If the Blue participant receives a signal indicating that the project is bad, he must reject it according to B’s payoff shown in Panel B; so, his or her expected compensation would be Bs. 0 (1,000 x 50% + -1,000 x 50%) whereas in the opposite case, if he approves the project his or her expected loss would be Bs. 2,500 (-2,000 x 50% + -3,000 x 50%).

Finally, consider a hypothetical case where the White participant receives a good signal indicating that the project could be successful, but the Blue participant rejects it (votes against the project). White has two options with the same expected compensation\(^5\): to approve the project (vote following his or her signal) and win Bs. 2,000 if his or her signal was correct (NPV >0 project), or lose Bs. 2,000 in the case if his or her signal was incorrect (NPV <0 project). But if White rejects the project, despite his or her own good signal (that is, herding on Blue participant's vote), and it turns out that his or her signal was correct (the project was indeed good) he loses Bs. 500; in the case where White signal's was actually false, that is, White received a incorrect signal and the project was indeed bad, he wins Bs. 500.

1. Motivation for Gray's Compensation table (CEO):

To determine Gray’s participant compensation by round we considered, first of all, that the CEO generally has incentives to approve the project regardless of its quality. The approval of new projects improves his or her power and personal benefits. Additionally, the CEO usually proposes the projects discussed in a board of directors.

2. Motivation for Blue's Compensation table (Director A):

Blue's compensation is linked directly to his or her signal. If Blue is rational, then he or she must accept the projects when he or she receives a good signal and reject the project when he or she receives a bad signal. This participant should behave like an efficient external director (Director A in the González (2002) model), whose fundamental function is to watch over the shareholders' interests. This last argument implies that director Blue must decide according to his or her information set about the quality of the project, that is, his or her signal.

3. Motivation for White's Compensation table (Director B):

The White participant represents all those directors who, while wanting to accomplish their goal of controlling management, feel insecure about their capacities to make certain decisions. Thus, they can be tempted to look for a conservative balance, which will not risk their reputation and vote along with the group (in this case, the Blue participant). The center of our study is the White participant (Director B in the González (2002) model), because it is his or her passive behavior to vote with the group, ignoring his or her own signal, what induces herding behavior inside the board of directors.

The White participant's compensation table is designed in such a way, that White has incentives to vote following his or her own signals, when it is the same as the Blue participant's vote. When his or her signal differs from the Blue participant's

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\(^5\) One can think of this as two Nash equilibria for a risk neutral White participant.
signal, two possible equilibria can occur: In the first possibility, White follows his or her own signal, ignoring the Blue participant's vote (not herding); in the second possibility, White ignores his or her signal and votes in the same way as the Blue participant (herding). Both alternatives have the same expected payoff; with this setting, the fraction of herding outcomes should be 50 percent. Therefore, the existence of herding behavior in this experiment is an empirical question.\footnote{6 Note we assume that White is a risk neutral individual. This is an assumption that is not difficult to accept because each participant received Bs. 25,000 at the beginning of the experiment (see below) to ensure that neither of them will lose any of their own money. Moreover, the amount of money involved in the experiment is very small, so the assumption of risk neutrality is natural.}

White's preference over the latter option (that is, to herd on Blue's vote) is the hypothesis of this study and it is what we intend to demonstrate experimentally.

G. Group compensation
For this experiment it is important to measure the "market" assessment of board decisions. To simulate this dynamic, a competition between two groups was organized in each session. In each session (after 30 rounds), the group that took a greater number of correct decisions, that is, approving good projects and rejecting bad projects, would keep all the profits obtained in each individual round; whereas the participants of the other team will only keep 50 percent of their profits. Theoretically, a situation such as the one described, would induce participants to think not only on his or her own profit in each round, but also based on the group's welfare, in the same way directors think about their company; so, too many incorrect decisions could harm the company, and therefore, the reputation of the directors, and their subsequent compensation. At the end of each round the quality of the project was revealed to all the participants.

H. Mechanics of the experiment
1. Prior to the rounds:
a) Each participant was given the instructions for the experiment with the individual's compensation tables.\footnote{7 Detailed instructions are available upon request.} Note that the objective of the experiment and the underlying theories are not mentioned at all to participants.\footnote{8 We considered that if the students had such information, they could behave consciously or unconsciously in relation to the model or against it, destroying the objectivity of the experiment.} b) Each participant's role is determined by a random drawing: Gray (CEO), Blue (director A) and White (director B).
c) The groups are divided and located in separate places, each one guided by one of the coordinators of the experiment.
d) Each participant is informed of the individual's compensation (see Table II) and how the group's performance affects it. The individual compensation tables were available for all the participants, so, the incentives and votes were common knowledge.
e) Each participant is assigned a fee of Bs. 25,000.00 (approximately $16) at the beginning of the study in order to finance any loses they might have. This amount would increase or decrease according to each individual's performance in each round and to the group's performance at the end of the session.

2. During the rounds:
Each round follows the steps described below:
- The Gray participant takes out the chip, which determines the project's quality (blue chip for a good project and red chip for a bad project).
- The Blue and White participants choose a number, which determines their level of competence (competent or incompetent).
- The coordinator of the experiment gives a signal to the Blue and White participants, according to their level of competence, about the quality of the project (good signal or bad signal).
- The Gray and Blue participants have up to two minutes to consider their decision. The White participant has as much time as he or she considers necessary to take his decision after the Blue participant's vote.
• The participants vote sequentially: the Gray vote first, Blue vote second and White vote third. All votes are announced aloud.
• The true quality of the project (good or bad) and the group's decision (right or wrong) is revealed to all members at the end of each round.
• The individual payoff for each member is calculated.
• The rounds follow one another until completing thirty rounds.

3. When concluding the rounds:
After finishing all the rounds:
• The numbers of correct decisions are compared between both groups to determine the winner of the session.
• The total payoff for each participant is calculated according to his or her individual gains and whether or not his or her group won or lost the session.

Analysis of the results
In Table III we show some preliminary results. For the White participant, 48 percent of his or her signals were “good”, but he or she approved 54 percent of the projects; this result suggests that the White participant ignored his own signal in some cases, maybe following the Blue or Gray participant. For the Blue participant, 49 percent of his or her signals were good and he voted to approve 51 percent of the projects. On the other hand, he received 51% bad signals but voted to reject 49 percent of the project. This shows that the Blue participant, as expected, tends to vote with his or her signal.

All in all, there are 462 observations for our analysis. The total fractions of efficient decisions (accept good projects and reject bad projects) were 70 percent. We took into consideration those in which the Blue participant's voting and the White participant's signals were contradictory regarding the quality of the project. In other words, when the Blue participant accepted the project and the White participant's signal indicated that the project was bad, or when the Blue rejected the project and the White signal indicated that the project was good. There were 273 observations in which there was a herding possibility. The other observations were ruled out because they did not provide additional information on the White's participant's tendency to ignore his own signals and follow the other participants.

Due to the design of the compensation table's design (See Table II), the expected cases for the White participant voting with his or her signal is 50 percent and the expected cases for the White participant voting together with the Blue participant, ignoring his or her signal (herding), is 50 percent. Table IV shows the results.

As Table IV shows, of the 273 rounds, which represented herding opportunities, the White participant ignored his own signal in 173 cases (63.37%). Out of these cases, 133 took place when the Gray and Blue participants' vote was the same and 48 when the Gray and Blue participants' vote was different. That is, the herding force was stronger when both, the CEO and director A vote in the same way. Note however, that session 2 was very unusual. After taking out this session's results, the herding occurrence increased in the whole experiment to an approximately 68 percent9.

This shows evidence that herding was present in the experiment. The next section gives a more formal treatment of these results.

Econometric results
A. Variables
The dependent variable used for all the regressions was the White participant’s vote (v_b) or the vote of director B using the players defined by González (2002). This is a binary variable that takes the value 1 when he or she accepted the project and 0 when he or she rejected it. The independent variables were Grey (v_g) and Blue (v_a) participants’ vote (or the CEO and director A, respectively) and the White participant’s signal (s_b). All of these variables are binary. In the cases of v_a and v_g, 1 is

9 In this session a group did not reach 30 rounds because one of its member went bankrupt; that is, lost all the initial capital (Bs. 25.000) given at the beginning of the experiment.
the value when the participant accepts the project (director A and CEO respectively) and 0 when the participant rejects it. In the case of \( s_b \), 1 indicates a good signal and 0 indicates a bad signal.

We used two data sets: the first including all of the observations (462), and the second including those observations in which the White participant's signal was opposite to the Blue participant's vote, that is when \( v_a \neq s_b \).

B. Results
To analyze the results, we used a Logit regressions model.\(^{10}\)

1. Results from all observations
The results using all the observations in the database (462) are presented on Table V. The null and alternative hypotheses in this case are:

\[
\begin{align*}
H_0: \alpha_2 &= 0; \alpha_3 = 0 \\
H_1: \alpha_2 > 0; \alpha_3 < 0
\end{align*}
\]

According to the results\(^{11}\) shown on the Table V we reject the null hypothesis \( (\alpha_2 = 0 \text{ and } \alpha_3 = 0) \), thus finding evidence in favor of the first alternative hypothesis \( (\alpha_2 > 0) \). Nevertheless, the results do not support the verification of the second alternative hypothesis \( (\alpha_3 < 0) \).

One of the possible reasons for not verifying the second alternative hypothesis is because in our database composed of 472 observations, in 189 cases (40 percent), both White participants (director B) and Blue participants (director A) received the same signal. In these cases, White participant's vote was exactly the same as the Blue participant's \( (v_b = v_a = s_b) \), so it is not possible to infer from these 189 cases any herding behavior in White.

2. Results with partial observations \( (v_a \neq s_b) \)
Tables VI and VII show the results of the 273 observations in which the signal of the White participant is different from the vote of the Blue participant, that is, situations where \( v_a \neq s_b \).

a) Case 1: A's vote influence on B's vote

\[
\begin{align*}
H_0: \alpha_1 &= 0 \\
H_1: \alpha_1 > 0
\end{align*}
\]

As is shown on Table VI, results allow us to reject the null hypothesis and choose in favor of the alternative hypothesis. That is to say, that the Blue participant's vote has a positive influence on the White participant's vote. Even though this is not conclusive for "herding behavior", it does demonstrate a positive relationship between these two events.\(^{12}\)

This result could be interpreted by highlighting the fact that the probability of White voting in favor of the project increases by a factor of 2.97 \( =\exp (1.08954) \) if Blue participant has also accepted the project.

b) Case 2: Influence of B's signal over his own voting

\[
\begin{align*}
H_0: \alpha_1 &= 0 \\
H_1: \alpha_1 < 0
\end{align*}
\]

As shown in Table VII, in this case the null hypothesis is rejected in favor of the alternative hypothesis; that is to say, that B's signal has a negative influence over its own voting. This result demonstrates the "herding behavior" or herding, because B's vote is contrary to his signal.

The probability that the White participant will accept the project is reduced by a factor of 0.33 \( =\exp (-1.08954) \) when he or she received a "good" signal.

It is important to mention again that the low pseudo R\(^2\) of these regressions (Table VI and Table VII) seems problematic due to the fact that there appears to be other independent variables that are not included in the model, but which may have explanatory power. The reader should take these results as only preliminary evidence of herding.

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10 See Gujarati (2003) for a discussion of this model.

11 We also ran this regression using a normally distributed variable with mean 0.5 and standard deviation of 0.2 to add "white noise" to the regression model, and the principal stated results remained valid.

12 The low pseudo R\(^2\) seems excessively low so we must interpret the results with caution.
Conclusions

This experimental study simulates a board of directors composed of a manager and two external directors. Consistent with González (2002), it was found that when the voting was done in sequence (CEO first, then director A, and finally director B), director B tends to ignore his own signal and follow the other director's decision, which suggests the presence of herding behavior.

The increase in the proportion of external directors, apparently does not improve the company's performance (Bhagat and Black, 2000), although conventional theory suggests that external directors should improve the monitoring role of management (Fama and Jensen, 1983). One of the reasons why the external directors' influence in company decisions might not have the desired impact on company performance is due to the tendency of outside directors to follow a leader on the board, and therefore ignoring their own information.

The results obtained in this experimental study allow us to draw the following conclusions:

- In the case of the board of directors, in which the behavior was simulated in this experiment, it was shown that there is a tendency for director B to ignore his or her personal information and follow director A (and the CEO in some cases). This result could serve as preliminary evidence of herding behavior among the board members.

- On the basis of these observations, the White participant (director B) ignored his signal in 63.37 percent of the cases (68 percent of the time when we take out session 2), presumably following the Blue participant's vote (director A), which would suggest the presence of herding.

- The econometric analysis showed that the Blue participant's (director A) vote has a positive influence on the White participant's (director B) vote. Additionally, the White participant's (director B) signal has a negative influence on his or her own voting, which could also be used as preliminary evidence of herding behavior in the experiment.

This study shines light on a possible explanation of why the impact of outside independent directors has not increased, on average, corporate performance.
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Table I  
General Characteristics of the Experiment

<table>
<thead>
<tr>
<th>Groups</th>
<th>2 groups of 3 people (CEO, Director A, and Director B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sessions</td>
<td>8 sessions with 2 groups in each session</td>
</tr>
<tr>
<td>Rounds per group</td>
<td>30 rounds per group</td>
</tr>
<tr>
<td>Number of participants</td>
<td>48</td>
</tr>
<tr>
<td>Profile of the participant</td>
<td>MBAs and Ms in Finance students.</td>
</tr>
<tr>
<td>Approximate cost</td>
<td>Bs. 1,050,000.00 ($650 aprox.)</td>
</tr>
</tbody>
</table>

Table II  
Individual Compensation Table
Payments figures are in bolivars (Bs.), the Venezuelan currency (the exchange rate at the time of the experiment was 1,600Bs./$)

A. Gray  
Project Quality

<table>
<thead>
<tr>
<th>Voting</th>
<th>NPV&gt; 0</th>
<th>NPV&lt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approve</td>
<td>1,000</td>
<td>-1,000</td>
</tr>
<tr>
<td>Reject</td>
<td>-3,000</td>
<td>-2,000</td>
</tr>
</tbody>
</table>

B. Blue  
Project Quality

<table>
<thead>
<tr>
<th>Signal</th>
<th>Voting</th>
<th>NPV&gt; 0</th>
<th>NPV&lt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Approve</td>
<td>1,000</td>
<td>-1,000</td>
</tr>
<tr>
<td></td>
<td>Reject</td>
<td>-3,000</td>
<td>-2,000</td>
</tr>
<tr>
<td>Bad</td>
<td>Approve</td>
<td>-2,000</td>
<td>-3,000</td>
</tr>
<tr>
<td></td>
<td>Reject</td>
<td>-1,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>

C. White  
Blue Voting

<table>
<thead>
<tr>
<th>Signal</th>
<th>White voting</th>
<th>NPV&gt; 0</th>
<th>NPV&lt; 0</th>
<th>NPV&gt; 0</th>
<th>NPV&lt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Approved</td>
<td>1,000</td>
<td>0</td>
<td>2,000</td>
<td>-2,000</td>
</tr>
<tr>
<td></td>
<td>Rejected</td>
<td>-3,000</td>
<td>-2,000</td>
<td>-500</td>
<td>500</td>
</tr>
<tr>
<td>Bad</td>
<td>Approved</td>
<td>500</td>
<td>-500</td>
<td>-2,000</td>
<td>-3,000</td>
</tr>
<tr>
<td></td>
<td>Rejected</td>
<td>-1,000</td>
<td>-1,000</td>
<td>0</td>
<td>1,000</td>
</tr>
</tbody>
</table>
Table III
Voting Description and Participant’s Quality Decisions

This table presents the signals, the voting and the accuracy of the decisions for each participant type (Gray, Blue and White) for all rounds and sessions. (*) A decision is considered accurate when a project is approved and later the project is identified as being good, or rejected when the project was indeed bad. The project is considered inaccurate otherwise.

<table>
<thead>
<tr>
<th></th>
<th>Gray (%)</th>
<th>Blue (%)</th>
<th>White (%)</th>
<th>Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>None</td>
<td>227</td>
<td>49%</td>
<td>220</td>
</tr>
<tr>
<td>Bad</td>
<td>None</td>
<td>235</td>
<td>51%</td>
<td>242</td>
</tr>
<tr>
<td><strong>Voting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accepted</td>
<td>373</td>
<td>81%</td>
<td>235</td>
<td>51%</td>
</tr>
<tr>
<td>Rejected</td>
<td>89</td>
<td>19%</td>
<td>227</td>
<td>49%</td>
</tr>
<tr>
<td><strong>Quality of decision</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accurate (*)</td>
<td>326</td>
<td>71%</td>
<td>296</td>
<td>64%</td>
</tr>
<tr>
<td>Not accurate</td>
<td>136</td>
<td>29%</td>
<td>166</td>
<td>36%</td>
</tr>
<tr>
<td>Average profit per session (Bs.)</td>
<td>14,821</td>
<td>21,678</td>
<td>25,089</td>
<td>61,588</td>
</tr>
</tbody>
</table>
Table IV
Frequency of “herding behavior” during the experiment

This table shows the different signal and voting combinations between participant Gray (CEO), participant Blue (director A) and participant White (director B), emphasizing the different signal (s) received by Blue and White.

(*) Cases in which the vote of the Blue participant (v_a) is different than the signal of the White participant (s_b), they represent the herding opportunities.

(**) Cases where the White participant ignores his or her signal and herds on the vote of the Blue participant.

<table>
<thead>
<tr>
<th>Sessions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>All</th>
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</thead>
<tbody>
<tr>
<td>Number of Rounds</td>
<td>48</td>
<td>54</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>462</td>
</tr>
<tr>
<td>Number of Groups</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Signal Comparison:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s_b the same as s_a</td>
<td>19</td>
<td>28</td>
<td>21</td>
<td>20</td>
<td>20</td>
<td>23</td>
<td>28</td>
<td>24</td>
<td>183</td>
</tr>
<tr>
<td>s_b different to s_a</td>
<td>29</td>
<td>26</td>
<td>39</td>
<td>40</td>
<td>40</td>
<td>37</td>
<td>32</td>
<td>36</td>
<td>279</td>
</tr>
<tr>
<td>Comparing Votes:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>v_b the same as v_a</td>
<td>35</td>
<td>35</td>
<td>48</td>
<td>45</td>
<td>42</td>
<td>47</td>
<td>53</td>
<td>49</td>
<td>354</td>
</tr>
<tr>
<td>v_a different to v_b</td>
<td>13</td>
<td>19</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>13</td>
<td>7</td>
<td>11</td>
<td>108</td>
</tr>
<tr>
<td>v_g the same as v_a</td>
<td>28</td>
<td>34</td>
<td>33</td>
<td>32</td>
<td>33</td>
<td>39</td>
<td>27</td>
<td>41</td>
<td>267</td>
</tr>
<tr>
<td>Decisive voting B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(v_g vote different to v_a)</td>
<td>20</td>
<td>20</td>
<td>27</td>
<td>28</td>
<td>27</td>
<td>21</td>
<td>33</td>
<td>19</td>
<td>195</td>
</tr>
<tr>
<td>Herding opportunities(*)</td>
<td>29</td>
<td>21</td>
<td>39</td>
<td>40</td>
<td>42</td>
<td>38</td>
<td>32</td>
<td>32</td>
<td>273</td>
</tr>
<tr>
<td>Herding(**)</td>
<td>16</td>
<td>3</td>
<td>27</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>26</td>
<td>23</td>
<td>173</td>
</tr>
<tr>
<td></td>
<td>55.17%</td>
<td>14.29%</td>
<td>69.23%</td>
<td>62.50%</td>
<td>61.90%</td>
<td>71.05%</td>
<td>81.25%</td>
<td>71.88%</td>
<td>63.37%</td>
</tr>
<tr>
<td>Other cases in which B ignores his or her signal</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>0,00%</td>
<td>4.76%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>4.76%</td>
<td>5.26%</td>
<td>3.13%</td>
<td>6.25%</td>
<td>2.93%</td>
</tr>
<tr>
<td>Herding when v_g is the same v_a</td>
<td>14</td>
<td>3</td>
<td>18</td>
<td>19</td>
<td>21</td>
<td>25</td>
<td>13</td>
<td>20</td>
<td>133</td>
</tr>
<tr>
<td></td>
<td>48.28%</td>
<td>14.29%</td>
<td>46.15%</td>
<td>47.50%</td>
<td>50.00%</td>
<td>65.79%</td>
<td>40.63%</td>
<td>62.50%</td>
<td>48.72%</td>
</tr>
<tr>
<td>Herding in a decisive vote</td>
<td>2</td>
<td>1</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>14</td>
<td>5</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>6.90%</td>
<td>4.76%</td>
<td>23.08%</td>
<td>15.00%</td>
<td>16.67%</td>
<td>10.53%</td>
<td>43.75%</td>
<td>15.63%</td>
<td>17.58%</td>
</tr>
</tbody>
</table>
### Table V
Logit regression results

\[ v_b = \alpha_1 + \alpha_2 v_a + \alpha_3 s_b \]

| v_b | Coef. | Std. Err. | z    | P>|z| | [95% conf. Interval] |
|-----|-------|-----------|------|-----|---------------------|
| v_a | 3.714669 | .3855604 | 9.634 | 0.000 | 2.958984 - 4.470353 |
| s_b | 2.627565 | .3849998 | 6.825 | 0.000 | 1.872979 - 3.382151 |
| _cons | -2.869399 | .3714777 | -7.724 | 0.000 | -3.597482 - 2.141316 |

Number of obs = 462  
LR chi2 (1) = 218.42  
Prob > chi2 = 0.0000  
Pseudo R2 = 0.3429

### Table VI
Logit regression results

\[ v_b = \alpha_1 + \alpha_2 v_a \]

| v_b | Coef. | Std. Err. | z    | P>|z| | [95% conf. Interval] |
|-----|-------|-----------|------|-----|---------------------|
| v_a | 1.08954 | .254832 | 4.276 | 0.000 | .5900786 - 1.589002 |
| _cons | -.2022369 | .1769912 | -1.143 | 0.253 | -.5491333 - .1446595 |

Number of obs = 273  
LR chi2 (1) = 18.96  
Prob > chi2 = 0.0000  
Pseudo R2 = 0.0512
**Table VII**  
Logit regression results

\[ v_b = \alpha_1 + \alpha_2 s_b \]

Logit estimates

Log likelihood = -175.6836

|       | Coef.    | Std. Err. |    z  |  P>|z| |  [95% conf.] |
|-------|----------|-----------|------|-----|-------------|
| s_b   | -1.08954 | 0.254832  | -4.276 | 0.000  | -1.589002   |
| _cons | 0.8873032| 0.1833397 | 0.000  | 0.527964 |

Number of obs = 273
LR chi2 (1) = 18.96
Prob > chi2 = 0.0000
Pseudo R2 = 0.0512