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AN ANALYTIC APPROACH TO MEASURE INFORMATION AGGREGATION AND EVALUATE THE STABILITY OF INFORMATIONAL CASCADES UNDER INCOMPLETE INFORMATION SETTINGS

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Abstract

Informational cascades describe a situation in which people observe the actions of others and then make the same choice, regardless of their own information. Behavioral conformity prevents information aggregation (Bikhchandani et al., 1992). However, under incomplete information settings, individual's information is a sample of the whole information pool as we are facing information more than we can handle in daily business routine. As we can rule out the possibility that predecessors get enough information to shatter a cascade if cascade continues, it is reasonable to consider there is information injected into cascade even when decision-maker follows predecessor's behavior. Taking this belief into consideration, we analyze the threshold point of convergence /deviation, and propose a model to measure Information aggregation and evaluate the stability of informational cascades under incomplete information settings. This model helps to optimize sequential decision-making process by utilizing the statistical aspects of informational cascades.

Keywords: Herd, Informational cascades, Information aggregation, Stability.

1 Introduction

Taking a glimpse of various kinds of monopoly or obligopoly market, enterprises hold their dominant position through various kinds of strategy. Some enterprises dominate the market by maintaining core-technology advances (e.g. Intel); some enterprises dominate the market by unique operational mode (e.g. Dell); some enterprises dominate the market by leading the fashion with innovation primarily focusing on funcations and user-experience (e.g. Apple). While developing strategies to enter markets like apple's kindom, the major problem we face is neither technical threshold nor business operation. The critical issue is whether and how we can attract the herding customers from apple. The first step to solve this managerial problem is to evaluate the stability of the customer herds.

The underling mechanisms of herd phenomenon have been studied extensively, but its stability has been far less understood. This leads to an embarassing situation that, we are using herd phenomenon and the mechanisms behind it to explain many things around us, but we don't know what we can do about herd behavior. For example, when we are in the wrong herding, we do not even know what kind of effort is needed to overcome it. This is partly due to that although herd behavior is a common phenonmenon, its underlying mechanisms have emotional, cognitive and behavioral components, and should involve the disiplines of economics, sociology and psychology.

Informational cascade, a mechanism revealed by Banerjee (1992) and Bikhchandani et al. (1992), has explored the rational aspect of herd behavior in an information-based way. An informational cascade occurs if an individual's action does not depend on his private information signal. This mechanism, together with sanction on deviant (Hirshlifer and Rassmusen, 1989), positive payoff externalities (Arthur, 1989), conformity preference (Henrich and Boyd, 1998), and communication channels (Rogers, 2003), constitute the primary mechanisms behind herd effect.

Informational cascade has been widely recognized in the fields of behavioral economics, financial market (Devenow and Welch, 1996), labor market (Kubler and Weizsacker, 2003), technology adoption (Duan et al., 2009; Walden and Browne, 2002), innovation (Melissas, 2005) and real estate (Pierdzioch et al., 2010) as well as social aspect such as politics (Bikhchandani et al., 1998), and legal issues (Farnsworth, 2007) in the past few years. Farnsworth (2007) claimed that the negative effects of informational cascades sometimes become a legal concern and laws should be enacted to neutralize them.

Traditional informational cascades theory ignores the influence of the decision-makers after a cascade start, thus encounter dilemma on providing explanation for the phenomenon that the more popular a product is, the more difficult to disobey an information cascade, e.g. Duan et al. (2009) sugest that that consumers pay more attention in adoption of less popular products. It also fails to explain the phenomenon that the longer the bandwagon continues, the more robust it becomes.

In our study, the influence of all the individuals in informational cascades will be discussed by measuring the information aggregation in the cascade, and the stability of the informational cascade will be evaluated with the amount of information needed to disobey it. We primarily focus on the rational aspect of herd behavior, and try to bridge the gap between descriptive behavioral economic theory and prescriptive managerial practice.

2 Theoretical Framework

2.1 Conceptual background

Informational cascades explored why decision-makers, after observing predecessors' behavior, choose to behave in the same way, regardless of their own information. It is generally believed that there are many situations in real life in which private information can not be accessed by others. Individuals in an informational cascade make decision fully depends on observing predicessors' action, thus the information contribution of decision-makers once a cascade start is neglegible. While considering the stability of an informational cascade, Bikhchandani et al. (1992) claimed that the "depth" of an information cascade need not rise with the number of adopters, and once a cascade has started, further adoptions are uninformative. This proposition is based on the rationale that only behavior can be observed, but the information leads to that behavior are not, so informational cascades prevent the aggregation of information.

Let's consider a simple case. While communication equipment provider A considering whether to develop new business in a country, it finds that 4 communication equipment providers formerly have business in the country are moving out. It might decide not to enter that country although its own judgment of the business perspective is positive. However, if the acquired positive information is strong, for example, the telecom service provider in the country plan to build more infrastructures, and this kind of positive information are in large quantity, company A might insist its own decision. This means that the quantity and quality of the acquired information has obvious influence on individual's decision. If 20 companies are moving out of that country, company A might feel there is more risk in the country.

This means that the more popular a cascade is, the more difficult to disobey it, which also means that every individual contribute to the stability of the cascades. It contradict what has been suggested by informational cascades that no information aggregation in a cascade.

Consider the rationale behind traditional informational carefully, we could find that, a heuristic behind it is that agent's belief that all the individuals make decision based on the same source of information, so their probability of making right judgment individually (without observing other's behavior) is the same. However, in nowadays business environment, this is rarely the case, as we are an age that we can always access information more than we can handle. Under this kind of incomplete information settings, every business unit's information is a sample of the whole information pool in daily business routine.

Therefore, we suggest that under incomplete information settings, informational cascades should explore how a decision-maker utilizes predecessors' behavior and her own information to optimize individual choice in a sequential decision process. There are three prescriptive conditions for our study (i.e. I. Actions are sequential. II. Decision-makers combine their private information signals with those of previous individuals to optimize their choice rationally. III. The information pool is large enough, that every individual's information can be treated as a sample from the pool.).

Given fixed information, personal knowledge, experience and other pschological assets (Hastie and Dawes, 2010) will determine the probability of making best choice to some extent, therefore herding phenomenon is a stochastic process rather than a fully ratioanal and determined one.

We admit the fact that predecessors' information are not observable, but a rational decision-maker could maximize the utility of predecessors' information by making decision based on not only the observation of predecessors' behavior but also the perception of predecessors' information, simply for the reason that cascade will continue in 2 scenarios (i.e. I. Individual's judgment based on private and available public information is consistent with cascade. II. Individual's judgment based on private and available public information differs from cascade giving insufficient information to reject a cascade. While a decision-maker follows a cascade, some information is added to the cascade. This is for the reason that followers can rule out the scenario that Individual's judgment based on private and available public information differs from cascade with sufficient information to reject a cascade.

That is to say, statistical characteristics of predecessors' information can be perceived from previous decision-makers' behavior. The analysis of information cascade in previous publications takes no consideration of these characteristic, thus leading to the flawed conclusion that decision-makers in a cascade have no contribution to the stability of information cascade, which faces a dilemma in providing explanation for the fact that the more popular a product is , the more difficult to shatter cascades. In our analysis, we distinguish the concept of perceived information from acquired information. By utilizing the statistical characteristic of perceived information, we consider all the individual choice behaviors contribute to stability of information cascade, as follower can always rule out the possibility that predecessor got enough information to shatter a cascade.

2.2 Decision scenarios

Let us consider the decision scenarios when individuals facing informational cascades under incomplete information settings, i.e., they are trying to acquire relative information from an uncertain event, but that event generate information sources more than an individual can fully acquire even with maximum effort. We define the modes in terms of whether the cascade is true or false, whether the individual's judgment is true or false, and whether the information that individual acquired is sufficient to shatter informational cascades. Therefore we get 2x3 decision senarios:

1) Giving that cascade is false, and the individual's judgment is also false.
2) Giving that cascade is false, the individual's own judgment is true, but the decision-maker has insufficient information to overcome the false information cascade.
3) Giving that cascade is false, the individual's own judgment is true, and there is sufficient information for the decision-maker to overcome the false information cascade.
4) Giving that cascade is true, and the individual's judgment is also true.
5) Giving that cascade is true, the individual's own judgment is false, and the decision-maker gets enough wrong information to insist on his own false judgment.
6) Giving that cascade is true, the individual's own judgment is false, but the decision-maker has insufficient information to disobey the information cascade.

Informational cascades will continue in scenario 1, 2, 4 and 6, but will shatter in scenario 3 and 5.

2.3 Theoretical model

The analysis underlying behavioral decision research is founded on expected utility theory (Neumann and Morgenstern, 1944). When the probabilities reflect decision-makers' beliefs, rather than scientific knowledge, the calculation produces subjective expected utility (Winterfeldt and Edwards, 1986).

An analogous rationale could be found as Bayesian Nash equilibrium. Mertens and Zamir (1985) suggest that the presence of incomplete information raises the possibility that we may need to consider a player's beliefs about other players' preferences, his beliefs about their beliefs about his preferences, and so on, much in the spirit of rationalizability. Although this idea serves for simutaneously decision making, the basic concept of considering a player's belief about other players' preferences, and so on could be also applicable to a sequential decision making process in informational cascades.

The cognitive decision process could be decomposed to 4 steps—observe information cascade, perceive predecessor's psychological status, acquire cross-sectional accessible information, and make judgment. Predecessor's psychological status can be perceived from observing the statistical characteristics of informational cascades, given that all the rational decision-makers are uncertainty avoidant. The purpose of taking action according to the informational cascades and cross-sectional accessible information is to maximize individual benefit, and to minimize risks.

By observing the other people's behavior, decision-makers could perceive whether other people's information is positive or negative, and the strength, amount and precision of information they have acquired, in order to increase the probability of making best choice as compared with taking action based only on cross-sectional accessible information.

Different decision scenarios exist even cascade continues as discussed previously. Though it is admitted that actual information can't be acquired, we can infer that predecessor hasn't got enough information to reject a cascade, that is to say senario 3 and 5 can not be the case for predecessors. This statistical exclusion suggests decision-maker contributes more or less information to the cascade.

What need to emphasize is that the perceived information is quite different from acquired information. The perceived information can be only negative or positive, but the content of the perceived information can be never captured. We can estimate the amount of other people's information according to whether the information cascade has continued or not in the statistical meaning (i.e. whether a decision-maker has enough information to shatter a cascade), but the real value of other people's information will never be received.

Bikhchandani et al. (1998) suggest that informational cascades can be shattered by external shock. A shock is actually information disclosure. We define the information needed to shatter a cascade as the indicator of the stability of informational cascades. There should be a threshold of the amount of information that a shock provides, when a shock is available to provide information above that that threshold both in amount, strength and precision, a shock is effective to shatter the cascade. The higher the threshold, more stable a cascade is.

Definition 1*: The stability of an informational cascade is defined as three-dimensional (i.e. amount, strength, and precision) threshold of the information disclosed by a shock that needed to shatter an informational cascade.*

Based on the above analysis, we make our first hypothesis.

Hypothesis 1a*: New information will be injected into informational cascades when new decision-makers join cascades, thus stabilize cascades.*

Positive information is continuously injected into cascade as bandwagon continues, more and more information is aggregated to the cascade. That is to say, as cascade continues, later decision-maker will face a more stable cascade, thus it naturally leads to our hypothesis 1b.

Hypothesis 1b*: Later decision-makers need information more than prior ones at least in one dimension of amount, strength and precision to disobey cascades.*

As informational cascade continues, Informational cascade becomes more and more stable, later decision-maker will have less probability of shattering the cascade given that no significant shock occurs. This psychological rationale will lead to the individual behaviour that later decision-makers will rely more on the cascade, that is to say they will rely less on their private information. This sequential individual behavioural aspect means that less information will be injected into a cascade by later decision-makers.

Another rationale lies in statistical information theory that later decision-makers need more information to shatter the cascade, the probability of following cascades increases. The actions to follow the cascade will be less informative.

Therefore, we get our second hypothesis.

Hypothesis 2a*: Later decision-makers contribute less to the stability of information cascades as compared to prior ones.*

Every individual's contribution to the stability of an informational cascade is the marginal stability of the informational cascade, as it the stability arises from an activity that individual follows a cascade. As less information is injected into a cascade by later decision-makers, it leads to the macro perspective of informational cascades in a statistical meaning, i.e. Hypothesis 2b.

Hypothesis 2b*: Marginal stability decreases in the sequence, if an informational cascade continues.*

Consider the acceptance of this article, if 3 well-recognized professors think this paper is acceptable, the editor will most likely accept it, but if 3 undergraduate students accept this paper, the editor might hesitate, that is the point that a cascade might shatter. People are always led by leaders. It is obvious that if predecessor has high probability of making best choice independently, the informational cascade will be more reliable. This means that the stability, one of the macro perspectives of informational cascades will increase thus leads to our third hypothesis.

Hypothesis 3*: The stability of informational cascades has positive relationship with the probability of the individual's making best choice independently.*

Farnsworth (2007) analyzed the legal aspects of informational cascades. For Example in many military courts, the officers voting to decide a case vote in reverse rank order (the officer of the lowest rank votes first), and he suggested it may be done so the lower-ranked officers would not be tempted by the cascade to vote with the more senior officers, who are believed to have more accurate judgment.

Considering the voting case in a forward sequence, we will probably find that senior officers's judgment is more likely to be accepted by later officers. That is to say, later decision-makers will be tempted by the cascade, and depend less on her own information. Therefore, we get our fourth hypothesis.

Hypothesis 4*: Once cascades formed, prior decision-makers' high probability of making best choice independently will make the cascades more convincing, thus later ones' information and judgment will be less valuable.*

Hypothesis 5a*: Higher probability of acquiring true information will increase individual's honesty to own judgment, thus it will be easy to disobey cascades at the very beginning.*

Hypothesis 5b*: However, Higher probability of acquiring true information will also accelerate the process of accumulating information, thus increase the difficulty to destabilize cascades for later decision-makers.*

Hypothesis 6*: Individual's contribution to the stability of information cascade once formed has positive relationship with the probability that acquired information is true.*

These hypotheses consider informational cascades in both macro and micro perspective. In macro perspective, we treat informational cascade as a whole to study its attribute, i.e. sequential length, information environment, external shock, stability and marginal stability. Accordingly in micro perspective, we focus on individual behaviour and optimized decision making under a rationale that some statistical characters of predecessors' information is perceptible or can be estimated.

3 Model Analysis

Decision making is more like a cascading process than a simultaneous one, so it is reasonable to consider each probability as a cascading component in our model.

According to Shannon's general formula for uncertainty (Shannon, 1948), information can reduce uncertainty. If there is such a measure, say H (p_1, p_2, $\cdots$, p_n), it is reasonable to require of it the following properties:

1. H should be continuous in the p_i.
2. If all p_i are equal, $p_i = 1/n$, then H should be a monotonic increasing function of n. With equally likely events there is more choice, or uncertainty, when there are more possible events.
3. If a choice be broken down into two successive choices, the original H should be the weighted sum of the individual values of H.

Quantities of the form $H=-K\sum p_i log p_i$ (the constant K merely amounts to a choice of a unit of measure) play a central role in information theory as measures of information, choice and uncertainty. Therefore, it is reasonable to put the amount of information as exponential composite while doing probability analysis, and the measure of uncertainty to be additive.

Define information's three dimensions $I \in R_+^3$. Like commodity utility, we define $U \in R$. For $\forall$ (Amount, Strength, Precision) $\in$ I. Function $u(\cdot)$, make mapping (Amount, Strength, Precision) $\rightarrow$ u, satisfy $u \in U$. We also define a u^* to be the threshold which reflect stability.

We make following notation before mathematical modeling:

p: the probability that individual's own judgment is true.

p is a value related with personal knowledge and experience, it reflect the possibilty of making best choice given fixed information.

α: the probability that corss-sectional accessed information is true.

λ_i: the amount of information needed to overcome information cascade for i^th decider.

s: the strength of the information.

For simplicity, we make an assumption that strength is a binary set, i.e. it can be only positive or negative. Then, if decision-maker get the information satisfy *u (Amount, Strength, Precision)* $> u^*$, then she meet the criteria to shatter an informational cascade.

Therefore, we get our information utility function as

$$u(amount, strength, precision) = u(\lambda, s, \alpha) = \begin{cases} \alpha^{\lambda}, for\ s = + \\ (1-\alpha)^{\lambda}, for\ s = - \end{cases}$$

We also made an assumption that all the decision-makers are ordinary people, i.e., their cognitive and judgmental ability are the same. It is a strong assumption to treat every decision-maker as homogeneous agent, but it is reasonable to some extent for people within a group might have simliar backgrounds.

Given a false cascade:

The probability that individual makes true judgment without observing other's behavior is *p*; and the probability that individual makes false judgment without observing other's behavior is (*1-p)*. The probability of acquiring enough true information to reject a false cascade is α^{λ}. Therefore, the probability that judgment is true and information is sufficient is $\alpha^{\lambda}p$; *the* probability that judgment is true but information is insufficient is $(1-\alpha^{\lambda})p$.

Given a true cascade:

The probability that individual makes true judgment without observing other's behavior is *p*; and the probability that individual makes false judgment without observing other's behavior is (*1-p)*. The probability of acquiring enough false information to reject a true cascade is $(1-\alpha)^{\lambda}$. Therefore, the probability that judgment is true and information is sufficient is $(1-\alpha)^{\lambda}\ p$; *the* probability that judgment is true but information is insufficient is $(1-(1-\alpha^{\lambda}))p$.

According to the above analysis, the conditional probability that each scenario will occur under given true/false cascade is depicted in Figure 1.

(judgment=false/ cascade=false) $1-p$	(judgment=true, Insufficient information/ cascade=false) $(1-\alpha^{\lambda_i})p$	(judgment=true, sufficient information/ cascade=false) $\alpha^{\lambda_i}p$
(judgment=true/ cascade=true) p	(judgment=false, sufficient information/ cascade=true) $(1-\alpha)^{\lambda_i}(1-p)$	(judgment=false, insufficient information/ cascade=true) $(1-(1-\alpha)^{\lambda_i})(1-p)$

Figure 1. The conditional probability of decision modes when individual facing cascades

Based on the 2x3 decision senarios, we perform sequential analysis to find out the exact information needed to shatter a cascade.

Define DM_i as ith individual's decision matrix.

$$DM_i = \begin{bmatrix} a_{i1} & a_{i2} & a_{i3} \\ a_{i4} & a_{i5} & a_{i6} \end{bmatrix}$$

a_{i1} denotes the conditional probability that scenario 1 occurs; a_{i2} denotes the conditional probability that scenario 2 occurs; a_{i3} denotes the conditional probability that scenario 3 occurs; a_{i4} denotes the conditional probability that scenario 4 occurs; a_{i5} denotes the conditional probability that scenario 5 occurs; a_{i6} denotes the conditional probability that scenario 6 occurs;

Define CM_i as cascade matrix, which indicate the probability of all the actions before ith decision-maker inclusively conform.

$$CM_i = \begin{bmatrix} c_{i1} \\ c_{i2} \end{bmatrix}$$

If *ith* individual's own judgment without taking cascade into consideration is different from cascade, we can make following conclusion about *ex ante* and *ex post* probability of whether cascades is true or false:

For *ith* decision-maker, $c_{i-1,1}$ denotes the *ex ante* probability that the information cascade is false, c_{i1} denotes the *ex post* probability that the information cascade is false; $c_{i-1,2}$ denotes the *ex ante* probability that the information cascade is true, c_{i2} denotes the *ex post* probability that the information cascade is true.

$$c_{i1} = c_{i-1,1} \times (a_{i1} + a_{i2})$$
$$c_{i2} = c_{i-1,2} \times (a_{i4} + a_{i6})$$

An informational cascade might be shattered only when the following two criteria have been met:

1. A decision-maker has different judgment from his/her cross sectional information as compared with what cascade indicates.
2. Individual percieve that he/she is more likely to make best choice while shattering cascade, i.e. he/she has higher probability in senario 3 than in senario 5.

Considering the condition an informational cascade might be shattered, λ should satisfy

$$c_{i-1,1}a_{i3} > c_{i-1,2}a_{i5}$$

For the *1st* decision-maker, she will simply follow her own decision:

$$DM_1 = \begin{bmatrix} 1-p & 0 & p \\ p & 1-p & 0 \end{bmatrix}$$

$$CM_1 = \begin{bmatrix} (1-p) \\ p \end{bmatrix}$$

$$\lim \lambda_1 = 0$$

For the *2nd* decision-maker, she will also follow her own decision:

$$DM_2 = \begin{bmatrix} 1-p & 0 & p \\ p & 1-p & 0 \end{bmatrix}$$

$$CM_2 = \begin{bmatrix} (1-p)^2 \\ p^2 \end{bmatrix}$$

$$\lim \lambda_2 = 0$$

For decision-makers from *3rd*, individuals might follow the cascade in order to maximize their own benefits, or shatter the cascade give that cross sectional information exceed threshold. Information cascade will end only when the individual percept that the probability that cascade is false and scenario 3 occurs exceeds the probability that cascade is true and scenario 5 occurs.

For the *3rd* decision-maker:

$$DM_3 = \begin{bmatrix} 1-p & (1-a^{\lambda_3})p & a^{\lambda_3}p \\ p & (1-a)^{\lambda_3}(1-p) & (1-(1-a)^{\lambda_3})(1-p) \end{bmatrix}$$

$$CM_3 = \begin{bmatrix} (1-p)^2((1-p)+(1-a^{\lambda_3})p) \\ p^2(p+(1-(1-a)^{\lambda_3})(1-p)) \end{bmatrix}$$

$$\begin{aligned} & c_{21}a_{33} > c_{22}a_{35}: \\ & a^{\lambda_3}p(1-p)^2 > (1-a)^{\lambda_3}(1-p)p^2 \\ & \longrightarrow \lambda_3 > \log_{\frac{a}{1-a}}(\frac{p}{1-p}) \end{aligned}$$

For the *4rd* decision-maker:

$$DM_4 = \begin{bmatrix} 1-p & (1-a^{\lambda_4})p & a^{\lambda_4}p \\ p & (1-a)^{\lambda_4}(1-p) & (1-(1-a)^{\lambda_4})(1-p) \end{bmatrix}$$

$$CM_4 = \begin{bmatrix} \prod_{i=1}^{4}(1-p)+(1-a^{\lambda_i})p) \\ \prod_{i=1}^{4}(p+(1-(1-a)^{\lambda_i})(1-p)) \end{bmatrix}$$

$$\begin{aligned} & c_{31}a_{43} > c_{32}a_{45}: \\ & a^{\lambda_4}p(1-p)^2((1-p)+(1-a^{\lambda_3})p) > (1-a)^{\lambda_4}(1-p)p^2(p+(1-(1-a)^{\lambda_3})(1-p)) \\ & \longrightarrow \lambda_4 > \log_{\frac{a}{1-a}}(\frac{p}{1-p}) + \log_{\frac{a}{1-a}}(\frac{p+(1-(1-a)^{\lambda_4})(1-p)}{(1-p)+(1-a^{\lambda_4})p}) \end{aligned}$$

Conduct similar analysis for the following decision-makers, we can conclude that:

$$\lambda_n > \begin{cases} 0, n=1,2 \\ \log_{\frac{a}{1-a}}(\frac{1-p}{p}) + \sum_{i=1}^{n-1}\log_{\frac{a}{1-a}}(\frac{p+(1-(1-a)^{\lambda_i})(1-p)}{(1-p)+(1-a^{\lambda_i})p}), n \geq 3 \end{cases}$$

The contribution of *nth* decision can be defined as:

$$\delta_n = \lambda_n - \lambda_{n-1} = \log_{\frac{a}{1-a}}(\frac{p+(1-(1-a)^{\lambda_i})(1-p)}{(1-p)+(1-a^{\lambda_i})p}), n \geq 3$$

$$\lim_{n\to\infty}\delta_n = 0$$

4 Validation

If sequence is long enough, individual contribution will be very small. In short time span, this kind of information aggregation can be almost neglected. This special circumstance coincide wtih what Bikhchandani et al. (1992) claimed. However, while considering the accumulation effect in a long time span, the aggregated information can't be neglected. This story tells us the the accumulation effect is very important in informational cascades under incomplete information settings. This accumualtion effect is something comparable to the story of non-perceptable differneces in individual's preferences provided by Mas-Colell et al. (1995).

Set total number of decision-makers to $N=10^2$, $\alpha=0.55$, $p=0.7$, we get the result as show in figure 2.

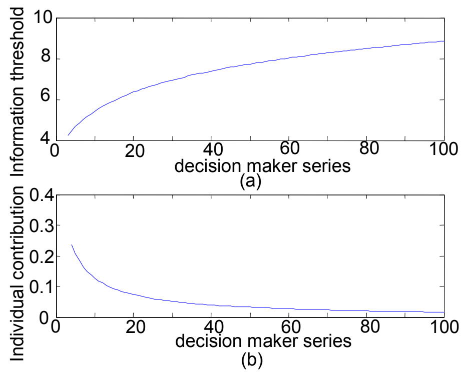

Figure 2. (a) Information threshold, (b) n^{th} decision-maker's contribution to information cascade.

The figure clearly indicate that later decision-makers need more information than prior ones to disobey cascades, and that later decision-makers contribute less to the stability of information cascades as compared with prior ones, which are in consistence with H1~H2.

In the following analysis, α varies from 0.55 to 0.95 given a fixed p of 0.7, in order to examine α*'s* influence on informational cascades.

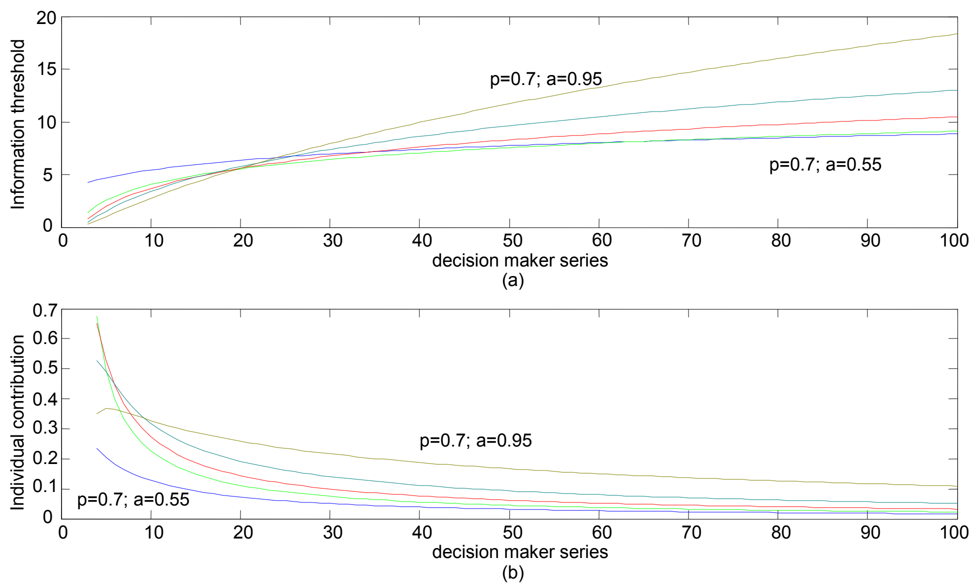

Figure 3. (a) Information threshold, (b) n^{th} decision-maker's contribution to information cascade while $\alpha=0.55$~0.95 given $p=0.7$.

Then p varies from 0.55 to 0.95 given a fixed α of 0.7, in order to examine p's influence on informational cascades.

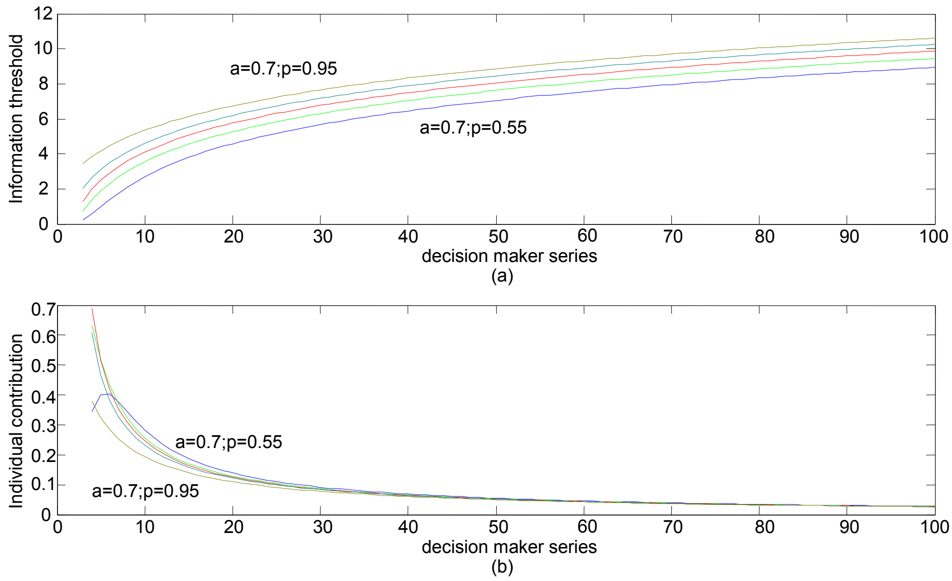

Figure 4. *(a) Information threshold, (b) n^{th} decision-maker's contribution to information cascade while p=0.55~0.95 given α=0.7.*

We find that α is positively related with the stability of informational cascades and information aggregation, while p has positive influence on the stability of information cascades at the beginning but will subtle negative influence on individual contribution once cascades formed. These results are in accordance with our hypothesis H3~H6.

5 Conclusion

There are innumerable situations that force executives to develop business strategy under incomplete information settings. Every business unit's information is a sample of the whole information pool as we are facing information more than we can handle in daily business routine.Information cascades form when the decision-maker find predecessors make identical choice, which provide observational evidence that outweighs individual's judgment from her own information. Informational cascades shatter when the decision-maker accessed information is strong enough to overcome the influence by observational learning.

This study developed a method to measure information aggregation and evaluate the stability of informational cascades under incomplete information settings. This work also made contribution to the theory of sequential decision making by analyzing the threshold point of convergence and deviation. When the decision sequence is long enough, we find that BHW (1992) is a good approximation in restricted time span under incomplete information settings.

6 Practical Implication

Providing an analytical method to evaluate the stability of informational cascades, we take first step to bridge the gap between descriptive behavioral economic theory and prescriptive managerial practice.

In micro perspective, we take predecessor's belief to get a statistical decision process at individual level. This process cost nothing but the statistical meaning of a cascade to maximize the probability of making best choice, i.e. minimize decision-maker's uncertainty. By providing a method to evaluate the stability of informational cascades, it may help executives to evaluate the risk of entering a market full of herd behavior.

In macro perspective, Herd behavior is recognized as one of the factors driving macroeconomic fluctuation. The stability of informational cascades may help government to evaluate the risk caused by herd behavior, and then find out what kind of policy would be strong enough to shatter an unhealthy herding.

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