

INFORMATIONAL CASCADE IN THE INSURANCE MARKET

S. Hun Seog

ABSTRACT

We develop an informational cascade model based on Bikhchandani, Hirshleifer, and Welch (1992) with applications to the insurance market. We investigate the existence of cascades and the effects of public information on cascades. We apply the results to insurance markets to explain how catastrophic events may lead to demand increases, how loss shocks may lead to insurance cycles, and how the heterogeneity of policyholders affects the choice of limited tort auto insurance in Pennsylvania.

INTRODUCTION

An informational cascade refers to a situation where an individual selects an action following others, ignoring his own private information (Bikhchandani, Hirshleifer, and Welch, 1992, hereafter BHW). An informational cascade is observed in diverse economic circumstances. Economics and finance literature has studied cascades under the assumption of rational economic agents. Among others, Banerjee (1992, 1993), BHW, Froot, Scharfstein, and Stein (1992), Scharfstein and Stein (1990), and Welch (1992) have developed cascade models to explain economic and social phenomena. Initial public offerings (IPOs) in the equity market are under priced in order to avoid a cascade because a slow initial sale would send an unfavorable signal. A manager in a firm may undertake an investment simply because other managers did. Investors with short-term horizons may herd, ignoring some information about fundamentals. Social phenomena such as fads, fashion, custom, and rumors are also good examples of cascades.

There are few applications of cascade effects in the insurance market. One exception is D'Arcy and Oh (1997). They use Welch's (1992) IPO model to study the cascade effects in pricing at the Lloyd's of London. The underwriting process at Lloyd's resembles an IPO process because the "lead" underwriter's decision provides a signal

S. Hun Seog is at KAIST Business School, Korea Advanced Institute of Science and Technology, 207-43 Cheongryangri-Dong, Dongdaemun-Gu, Seoul 130-012, Korea. The author can be contacted via e-mail: seogsh@business.kaist.ac.kr. I gratefully acknowledge the financial support of the KAIST. I would like to thank two referees, Richard MacMinn, Georges Dionne, and the participants in the Asia-Pacific Risk and Insurance Association meeting and in the American Risk and Insurance Association meeting in 2003 for their comments. I would also like to thank Thi Nha Chau for her support.

to subsequent underwriters. Subsequent underwriters may ignore their private information and follow the previous underwriters. D'Arcy and Oh focus on Lloyd's underwriting, because underwriting in the conventional insurance market does not proceed sequentially.¹

This article attempts to apply the cascade model to the case of insurance purchases from which we draw some implications for the real world insurance market. While actual decisions for insurance purchases are made in more complicated ways, a cascade theory may provide some meaningful insights, because the insurance demand seems to be often affected by other policyholders and overreacts to some extreme events. It is well recognized that word of mouth is one of the important factors in insurance demand (e.g., Berger, Kleindorfer, and Kunreuther, 1989; Seog, 1999; Doherty and Seog, 2000; Taylor, 2001).² In addition, the demand for insurance may overreact to some extreme events (Browne and Hoyt, 2000; California Department of Insurance, 2002).

Based on BHW, this article develops a simple model to investigate the cascade effects in insurance purchases, the role of public information in breaking cascades, and the effects of heterogeneous consumers on cascades. We then discuss the implications of the results. We relate the cascade effects with insurance cycle and crisis. Our results provide some intuitions as to how events such as loss shocks affect consumers' expectation and the demand for insurance. Finally, we apply our theory to the recent observation of the choice of limited tort auto insurance in Pennsylvania (Regan, 2001).

While this article is built on BHW, it differs from BHW in the following aspects: First, we are concerned with the insurance demand of risk-averse consumers and the insurance cycle. Second, we consider more closely the effect of public information: how the public information breaks and creates the cascades and how subsequent public information affects the cascades. Note that BHW are concerned with the fragility of the cascades and asymptotic feature related to public information. In addition, public information changes the price of insurance as well as updates information in our case, while it simply updates information in BHW. Finally, we also consider the effect of heterogeneity of consumers (in their attitudes toward risk), while BHW consider homogeneous consumers only.³

The remainder of the article is structured as follows. In the section "The Model," the model is described. The section "Informational Cascades" studies the possible cascades. The section "Public Information" investigates the effect of public information on the cascades. The section "Heterogeneity" focuses on the effect of heterogeneity of consumers on the cascades. We apply the results of the model to the insurance market in the section "Application to the Insurance Market." The last section concludes.

¹ D'Arcy and Oh (1997) characterize pricing in the conventional market as "competitive market pricing" or "cooperative pricing with no cascades."

² It should be noted that a cascade model is only one specific approach to word-of-mouth that is also extensively studied in the network or information dissemination contexts (e.g., see Dodson and Muller, 1978; Reingen and Kernan, 1986; Brown and Reingen, 1987; Berger, Kleindorfer, and Kunreuther, 1989; Mahajan, Muller, and Bass, 1990).

³ Smith and Sørensen (2000) also consider the case of heterogeneous consumers, with a focus on long-run outcomes.

Appendixes A and B provide proofs of propositions and a mean–variance model, respectively.

THE MODEL

Homogeneous consumers face an insurable loss X .⁴ The probability of loss, R , can be g or b , where $g > b$. Based on public information, the probability that $R = g$ is one-half. Thus, the *ex ante* probability of loss is $v = (g + b) / 2$. Consumers can purchase insurance, which occurs in sequence. We assign numbers to consumers based on their order: $i = 1, 2, \dots$. Each consumer receives private information or a signal before he makes a decision. In addition, each consumer, with the exception of the first consumer, can observe the previous consumers' purchasing decision. Based on private information and observation, each consumer decides whether or not to purchase insurance. For simplicity, we assume that once consumers decide to buy, they purchase full insurance.

Each consumer receives independently private information $S = H$ or L .⁵ We assume that $P(H | g) = P(L | b) = p$, $P(H | b) = P(L | g) = 1 - p$. By Bayes' rule, we have $P(g | H) = P(b | L) = p$, $P(g | L) = P(b | H) = 1 - p$. Thus, given private information, the *ex post* average probability of loss becomes $v_H = P(\text{loss} | H) = pg + (1 - p)b$, given H and $v_L = (1 - p)g + pb$, given L .

A consumer's information will be denoted in a vector form. For example, suppose consumer 3 receives private information H and observes that consumer 1 did not purchase insurance and consumer 2 purchased insurance. Then, consumer 3's information can be denoted by $(01H)$, where 0 means no insurance and 1 means purchasing insurance. Based on the information, the consumer will decide whether or not to purchase insurance. More formally, we denote the decision function of consumer n as B_n , a function of information. B_n can have values of 0 (no insurance) or 1 (purchasing insurance). When consumer n receives private information $S = S_n$ and observes $(B_1 B_2 \dots B_j \dots B_{n-1})$, his information becomes $(B_1 B_2 \dots B_j \dots B_{n-1} S_n)$. If the private information of the previous consumer j can be inferred as S_j , then B_j can be replaced with S_j in the information vector.

The insurance premium is determined based on the public information. As the probability of loss is v , the premium equals vX + loading, where the loading is nonnegative. To make our analysis interesting, we assume that the loading premium is not very high, so that a consumer will purchase insurance if he has no private information. This assumption implies that a consumer with information H will also purchase insurance. We further assume that a consumer with information L will not purchase insurance because the premium is too high when compared to his private information. Table 1 summarizes basic notations.

⁴ While the assumption of homogeneous consumers simplifies our analysis, it is not realistic. For example, insurance premiums will be different across consumers with different risks. In this case, observing insurance purchase of other consumers may provide noisy information regarding a consumer's risk. Our model will be more applicable to the case in which consumers in a group face a similar risk, for example, insurance against earthquake or hurricane risks in a town, or travel insurance. The section on "Public Information" investigates the case where consumers are heterogeneous in their risk attitudes.

⁵ Private information can be interpreted as a signal deduced from personal experience or personal information sources regarding the risk.

TABLE 1
Basic Notations

Loss: X

Probability of loss: $R = g$ or b .

Probability that $R = g$ or b : $1/2$, each

$P(\cdot)$: probability operator

Ex ante average probability: $v = (a + b)/2$

Private information: $S = H$ or L

	H	L
R	$P(H R)$	$P(L R)$
g	p	$1 - p$
b	$1 - p$	p

$$P(g | H) = P(g, H) / P(H) = P(H | g)P(g) / [P(H | g)P(g) + P(H | b)P(b)] = p / [p + (1 - p)] = p$$

$$P(b | L) = p$$

$$P(g, H) = P(b, L) = p/2, P(g, L) = P(b, H) = (1 - p)/2$$

Ex post average probability of loss under the private information:

$$v_H = P(\text{loss} | H) = pg + (1 - p)b, v_L = (1 - p)g + pb$$

INFORMATIONAL CASCADES

The following rules will simplify our analysis.

Rule 1: If a consumer has information of (HL) , then $P(g | H, L) = 1/2$.

Proof: $P(g | H, L) = P(g, H, L) / P(H, L)$.

$$P(H, L) = P(H, L | g)P(g) + P(H, L | b)P(b) = (1/2)[p(1 - p) + p(1 - p)] = p(1 - p).$$

$$P(g, H, L) = P(H, L | g)P(g) = (1/2)p(1 - p).$$

Thus, $P(g | H, L) = 1/2$. □

Rule 1 implies that if a consumer has information of (HL) , then his information is not different from “no (private) information.” Thus, a consumer with (HL) would purchase insurance under our assumptions.

Rule 2 [Cancellation Rule]: $P(g | nH, mL) = P(g | (n - m)H)$ for $n \geq m$, or $P(g | (m - n)L)$ for $m > n$, where $nH(mL)$ implies that the number of information $H(L)$ is $n(m)$.

Proof: We only prove the case of $n \geq m$. $P(g | nH, mL) = P(nH, mL | g)P(g) / P(nH, mL)$. As $P(nH, mL) = (1/2)p^m(1 - p)^m[p^{n-m} + (1 - p)^{n-m}]$ and $P(nH, mL | g)P(g) = (1/2)[p^n + (1 - p)^m]$, we have $P(g | nH, mL) = p^{n-m} / [p^{n-m} + (1 - p)^{n-m}] = P(g | (n - m)H)$.

Rule 2 implies that information H and L can cancel out each other. This result is due to our symmetry assumption of $P(H|g) = P(L|b)$. Consumers can ignore both H and L because they provide opposite and symmetric signals. Rule 1 is obtained by putting $n = m = 1$ in Rule 2. For later uses, we also note that $P(nH, nL) = p^n(1-p)^n$, $P((n+1)H, nL) = p^n(1-p)^n/2$, and $P(g|LL) = (1-p)^2 / [(1-p)^2 + p^2]$.

Let us investigate the possibility of a cascade. As assumed, consumer 1 will purchase insurance if he receives H and will purchase no insurance if he receives L . Now consider consumer 2. Suppose that consumer 1 purchased insurance. In this case, the private information of consumer 1 is revealed as H . If consumer 2 receives L , his information is (HL) . By Rule 1, consumer 2 will purchase insurance. It is clear that consumer 2 will also purchase insurance when he receives H . As a result, consumer 2 will purchase insurance regardless of his information, once consumer 1 purchased insurance. In notation, we have $B_2(1-H) = B_2(1-L) = 1$.

Now suppose that consumer 1 did not purchase insurance. The private information of consumer 1 is revealed as L . If consumer 2 receives H , his information is (LH) . Thus, consumer 2 will purchase insurance by Rule 1. On the other hand, consumer 2 will not purchase insurance if he also receives L . In notation, we have $B_2(0H) = 1$, $B_2(0L) = 0$.

Now consider consumer 3. There are six possible cases of information: $(11H)$, $(11L)$, $(01H)$, $(01L)$, $(00H)$, and $(00L)$. When he observes that both previous consumers purchased insurance, purchasing insurance is optimal regardless of his private information. Therefore, $B_3(11H) = B_3(11L) = 1$. If both previous consumers purchased no insurance, then it implies that both consumers receive L . In this case, the information of consumer 3 who receives H becomes $(LLH) = L$. Thus, consumer 3 will not purchase insurance, regardless of his private information: $B_3(00H) = B_3(00L) = 0$. On the other hand, $B_3(01H) = 1$ because $(01H)$ implies $(LHH) = H$. And, $B_3(01L) = 0$ because $(01L) = (LHL) = L$.

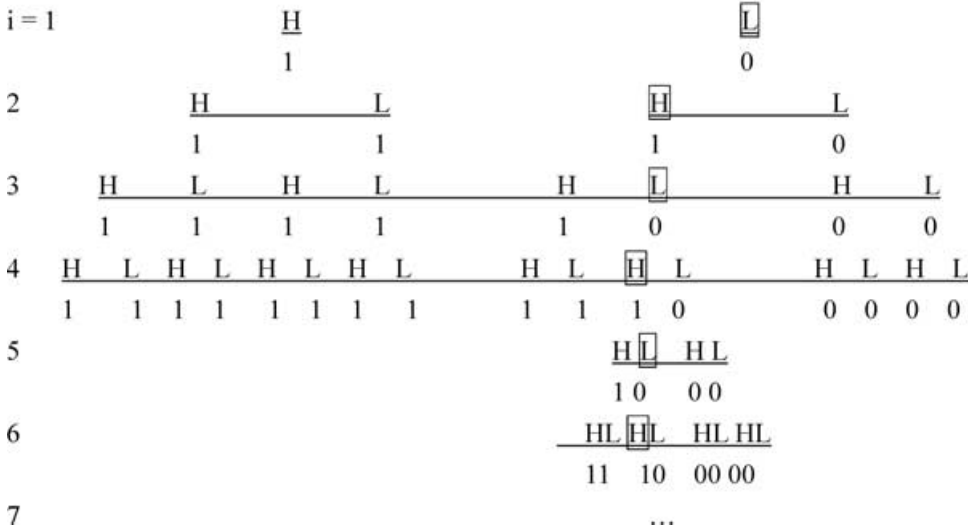
The above observation implies that when consumer 1 purchases insurance, the following consumers purchase insurance regardless of their own private information. In this case, we say that a 1-cascade (cascade of purchasing insurance) begins with consumer 1. When the first two consumers purchase no insurance, the following consumers purchase no insurance regardless of their own information. In this case, we say that a 0-cascade (cascade of purchasing no insurance) begins with consumer 2. On the other hand, if consumer 1 purchased no insurance and consumer 2 purchased insurance, then a cascade does not yet begin.

In general, by applying Rule 1 and Rule 2, we obtain the following results: Two consecutive L s after no information initiates a 0-cascade. One H after no information initiates a 1-cascade. The only case in which no cascade occurs is that H and L iterate after consumer 1 receives L . Figure 1 shows the decision sequence of consumers. No cascade occurs following the boxed array of private information in Figure 1.

The following proposition summarizes the probabilities of a 0-cascade, a 1-cascade, and a no-cascade. Limit probabilities show that a cascade eventually occurs.

FIGURE 1
Cascades in the Decision Sequence

- Decision: 0 = purchasing no insurance; 1 = purchasing insurance



Proposition 1:

(i) 0-cascade:

$$P(0\text{-cascade begins with consumer } 2n + 2) = (1/2)p^n(1-p)^n[(1-p)^2 + p^2].$$

$$P(\text{consumer } 2n + 2 \text{ is in } 0\text{-cascade}) = [(1-p)^2 + p^2][1 - p^{n+1}(1-p)^{n+1}]/2[1 - p(1-p)].$$

(ii) 1-cascade:

$$P(1\text{-cascade begins with consumer } 2n + 1) = (1/2)p^n(1-p)^n.$$

$$P(\text{consumer } 2n + 1 \text{ is in } 1\text{-cascade}) = [1 - p^{n+1}(1-p)^{n+1}]/2[1 - p(1-p)].$$

(iii) No-cascade:

$$P(\text{consumer } 2n + 2 \text{ is in no-cascade}) = p^{n+1}(1-p)^{n+1}.$$

$$P(\text{consumer } 2n + 1 \text{ is in no-cascade}) = p^n(1-p)^n/2.$$

(iv) Limit probabilities:

$$\lim_{n \rightarrow \infty} P(\text{consumer } 2n + 2 \text{ is in } 0\text{-cascade}) = [(1-p)^2 + p^2]/2[1 - p(1-p)].$$

$$\lim_{n \rightarrow \infty} P(\text{consumer } 2n + 1 \text{ is in } 1\text{-cascade}) = 1/2[1 - p(1-p)].$$

$$\lim_{n \rightarrow \infty} P(\text{consumer } n \text{ is in no-cascade}) = 0.$$

Proof: For proof of Proposition 1, see Appendix A.

PUBLIC INFORMATION

Now let us introduce public information, S' , into the model. By definition, the public information is observed by all economic agents including consumers and insurance firms. Assume that S' can have values of H' or L' . We assume that $P(H' | g) = P(L' | b) = s$, $P(H' | b) = P(L' | g) = 1 - s$, where $s \geq 1/2$. By Bayes' rule, we have $P(g | H') = P(b | L') = s$, $P(g | L') = P(b | H') = 1 - s$. The probability of loss with S' is calculated as $v_{S'} = gP(g | S') + bP(b | S')$.

Suppose that the public information $S' = H'$. When consumer 1 receives private information L , his information becomes $(H'L)$. The probabilities of $R = g$, and of $R = b$ and the probability of loss given information $(H'L)$, $v_{H'L}$, are calculated as follows:

$$\begin{aligned} P(g|H', L) &= P(H', L|g)P(g)/[p(H', L|g)P(g) + P(H', L|b)P(b)] \\ &= s(1-p)/[s(1-p) + (1-s)p]. \\ P(b|H', L) &= (1-s)p/[s(1-p) + (1-s)p]. \\ v_{H'L} = P(\text{loss}|H', L) &= gP(g|H', L) + bP(b|H', L) \\ &= [gs(1-p) + b(1-s)p]/[s(1-p) + (1-s)p]. \end{aligned}$$

Note that $P(g|H', L)$ increases and $P(b|H', L)$ decreases in s . For consumers with information $(H'LL)$, we have

$$\begin{aligned} P(g|H', L, L) &= s(1-p)^2/[s(1-p)^2 + (1-s)p^2], \\ P(b|H', L, L) &= (1-s)p^2/[s(1-p)^2 + (1-s)p^2]. \end{aligned}$$

Similar calculations for $S' = L'$ show:

$$\begin{aligned} P(g|L', L) &= (1-s)(1-p)/[(1-s)(1-p) + sp], \\ P(g|L', L, L) &= (1-s)(1-p)^2/[(1-s)(1-p)^2 + sp^2]. \end{aligned}$$

When there was no public information as was considered in the previous sections, the insurance premium could be assumed fixed. However, recall that public information affects insurance premium. When public information is announced, the insurance premium will be revised reflecting it. As a result, the effect of private information will vary with premium change. The effect of the premium change on a consumer's decision also depends on the shape of the utility. To illustrate the relation between the effect of the public information and utility, we present a simple mean–variance model in Appendix B.

Breaking a 0-Cascade

Let us describe briefly how the public information can break and create a cascade. Suppose that a 0-cascade is present and the public information is not revealed yet. Consider a new consumer, say n , who receives H . As he can only infer the information of LL from previous consumers, his information becomes $(LLH) = L$. Thus, he will not purchase insurance. Now assume that the public information $S' = H'$ is revealed just before he should make a decision. Suppose that the public information H' is such that the consumer with $H'L$ prefers to purchase insurance while the consumer with $H'LL$ prefers to purchase no insurance (see Appendix B for the existence of such public information.) With this public information, consumer n will have information of $(H'LLH) = (H'L)$. By our assumption, he will purchase insurance and the 0-cascade is broken. If the next consumer $n + 1$ also receives H , then his information is $(H' LH) = H'$. He will also purchase insurance and a 1-cascade begins.

On the other hand, if the consumer $n + 1$ receives L , then he will purchase no insurance because his information is $(H'LLHL) = (H'LL)$. If consumer $n + 2$ also receives L , then a new 0-cascade begins. In this way, the release of public information can break a cascade and create a new cascade.⁶ Note that breaking a cascade does not necessarily mean

⁶ Appendix B illustrates how public information can break a 0-cascade in a mean–variance model.

that another cascade should begin. The above observation with additional analysis leads to the following proposition.

Proposition 2:

- (i) *Public information may break a 0-cascade.*
- (ii) *Public information L' may have greater impact in breaking a 0-cascade than H' .*

Proof: For proof of Proposition 2, see Appendix A.

Proposition 2(ii) is interesting because it implies that consumers may purchase insurance when the probability of loss is low (L'), while they may not when the probability of loss is high (H'). The reason can be explained as follows. Consider a consumer with ($S'L$). Note that the probability of loss and the premium are high (low) when $S' = H'$ (L' , respectively), compared to the case of no public information. In addition, the private information L reduces the subjective probability of loss. However, the effect of L on the decision to purchase insurance depends on the level of premium. While the expected utility is reduced by (subjective) overpayment of premium, the reduction in the expected utility is smaller under low premium than under high premium for a risk-averse consumer.⁷ Therefore, the reduced expected utility can be still higher than the expected utility with no insurance under low premium, while it is not the case under high premium.⁸ This result implies that a consumer may purchase insurance with $L'L$, while he may not, with $H'L$. In the mean-variance model of Appendix B, Proposition 2(ii) occurs for a consumer with ($S'L$) if $g(1-p) < bp$, or $p > g/(g+b)$.

Breaking a 1-Cascade and a No-Cascade

The same logic as above can be applied to the case of a 1-cascade. However, the results are somewhat different. A 1-cascade cannot be broken. Once a 1-cascade is present, the information revealed by the previous consumers is H . Now, suppose the public information S' is announced. A new consumer who receives private information of L will have information of ($S'HL$) = S' . Under our assumption that a consumer with no private information will purchase insurance, a consumer with $S'HL$ will purchase insurance. Therefore, a 1-cascade is sustained, regardless of the public information.

Now suppose that no cascade occurs. Note that a no-cascade is observed if H and L iterate. Consider a consumer with L who follows a consumer with H . Without any public information, the consumer would not purchase insurance. Suppose now that public information S' is revealed just before the consumer decides. The consumer then has information of ($S'LHLH \dots LHL$) = ($S'L$). If we assume, as in the previous section, that the information $S'L$ leads to the purchase of insurance, then a consumer with ($S'L$) will purchase insurance. Once a consumer with private information L purchases insurance, a 1-cascade begins because the next consumer cannot learn any private information from him.

⁷ If we further assume that the premium loading is smaller for lower premium, then this result is reinforced.

⁸ However, the utility difference between with no insurance and with insurance is also smaller under low premium. Thus, this result does not always hold. Our purpose is to point out the possibility (see Appendix B).

On the other hand, any public information cannot prevent a consumer with private H from purchasing insurance because the consumer will have information $(S'LHLH \dots LH) = S'$. Thus, public information may initiate a 1-cascade but not a 0-cascade. In general, public information tends to work favorably toward purchasing insurance, because we assume that consumers with no private information will purchase insurance. The discussion is summarized in the following proposition.⁹

Proposition 3:

- (i) *Public information cannot break a 1-cascade.*
- (ii) *Public information may break a no-cascade and initiate a 1-cascade. However, public information cannot initiate a 0-cascade.*

Sequence of Public Information

As in the above subsection “Breaking a 0-Cascade,” suppose that the public information H' is such that a consumer with $(H'L)$ prefers to purchase insurance while a consumer with $(H'LL)$ prefers to purchase no insurance. Suppose also that H' broke a 0-cascade and initiated a 1-cascade. The information revealed by this new 1-cascade is then $(H'LLHH) = H'$. Now suppose that another public information L' is revealed just before a new consumer receives L . The consumer will have information of $(H'L'LLHHL) = L$. Thus, he will not purchase insurance. If the next consumer also receives L , then the 0-cascade is recovered.

Similarly, when H' broke a no-cascade at a consumer with L and initiated a 1-cascade, the information revealed by this new cascade is $(H'LH \dots LH) = H'$. Thus, a new consumer with L right after the new public information L' is revealed will have information of $(H'L'LH \dots LHL) = L$. Thus, he will not purchase insurance. If the next consumer also receives L , then a 0-cascade begins.

These observations imply that a 1-cascade initiated by previous public information can be broken and reversed to a 0-cascade by new public information. This is in contrast with the fact that the original 1-cascade cannot be broken by public information. The next proposition summarizes the results.¹⁰

Proposition 4: *Public information may break a 1-cascade initiated by previous public information.*

HETEROGENEITY

Let us change the assumption and suppose there are two types of consumers: types A and a . Consumers of type a are none other than those considered in the previous sections. Consumers of type A are more risk averse, so that A -consumers will purchase

⁹ BHW show that all consumers welcome public information after starting of a cascade, which is similar to our results, because public information can break a 0-cascade only. However, public information changes the price of insurance as well as updates information in our case, while it simply updates information in BHW.

¹⁰ This result is also in contrast with BHW showing that consumers eventually end up with a correct cascade (i.e., purchase insurance in our context) as the amount of public information becomes large. The change of price following public information makes private information more important in our case than in BHW.

insurance with (L) or (LL), but not with (LLL). We assume that the proportion of type A is r . Consumers cannot directly observe each other's type. In this setting, we will investigate the effect of heterogeneity of consumers on the demand for insurance.

Suppose that consumer 1 purchased insurance. Consumer 2 of type a with private H will purchase insurance. If consumer 2 receives L , then consumer 2 has information of $1L$. Considering that consumer 2 cannot observe consumer 1's type, we have:

$$\begin{aligned} P(g; 1L) &= p(1 = A)p(g; L) + p(1 = a)p(g; HL) = r(1 - p) + (1 - r)(1/2) \\ &= -(2p - 1)r/2 + 1/2. \end{aligned}$$

Note that as r increases to 1, $P(g; 1L)$ decreases to $1 - p$. This implies that, if r is high enough, then consumer 2 will not purchase insurance even if consumer 1 purchased insurance. On the other hand, if r is low enough, then consumer 2 will purchase insurance, and all subsequent a -consumers will also purchase insurance. This is because as r increases, consumer 1 is more likely to be of type A . Thus, it is more difficult for consumer 2 to deduce private information from him. As a result, consumer 2 relies more on his own information. However, if r is low enough, then consumer 1 is more likely to be of type a . Therefore, the purchase of insurance by consumer 1 provides information of H .

Now suppose that consumer 1 did not purchase insurance and consumer 2 of type a receives H . Note that consumer 1 is revealed to be of type a , because he did not purchase insurance. Then, $P(g; 0H) = p(g; LH) = 1/2$. Thus, consumer 2 will purchase insurance. If consumer 2 receives L , then he will not purchase insurance, because he has information of (LL). Now suppose that consumers 1 and 2 did not purchase insurance and consumer 3 of type a receives H . As $P(g; 00H) = P(g; LLH)$, consumer 3 will not purchase insurance, which is similar to the case of the homogeneous consumer.¹¹

In sum, the effect of the introduction of more risk averse consumers is not symmetric. An a -consumer with ($1L$) may not purchase insurance unlike in the homogeneous case, while he does not purchase insurance with ($00H$) like in the homogeneous case. Interesting is the observation that the possibility of purchasing insurance by a -consumers is reduced with the introduction of consumers of type A . The general implication is that the introduction of more risk averse consumers tends to reduce the demand for insurance by less risk averse consumers. This is because the behavior of previous consumers carries less clear information for H and clearer information for L , because more risk averse consumers purchase insurance with information with which the less risk averse consumers would not.

If we introduced less risk-averse consumers, it would work favorably toward purchasing insurance, because, in that case, purchasing insurance carries clearer information of H while purchasing no insurance carries less clear information of L . The above observation is an example of a more general result discussed in the following proposition.

¹¹ As all consumers who did not purchase insurance are of type A , consumers are indeed homogeneous. However, unlike in the homogeneous case, we cannot have a 0-cascade because consumers of type A will always purchase insurance.

Proposition 5:

- (i) *In the two-type consumer model, consumers of different types tend to behave in opposite ways more than they would when there is no other type of consumers.*
- (ii) *As the proportion of less (more) risk averse consumers increases, the more (less) risk averse consumers tend to purchase insurance (no insurance).*

Proof: For proof of Proposition 5, see Appendix A.

Note that the critical point in our discussion is how clearly the consumer can deduce the information from the behavior of previous consumers. For example, as the proportion of more risk averse consumers increases, the less risk averse consumers deduce from previous consumers information L more clearly and information H less clearly than before. As a result, consumers of different types tend to behave in opposite ways more than they would when there is no other type of consumers. This behavior makes a cascade more difficult because private information becomes more valuable (see Smith and Sørensen, 2000).

In an extreme case, it is possible that the total demand for insurance is lower when the proportion of more risk averse consumers is higher. More risk averse consumers will tend to increase the demand for insurance. On the other hand, the demand for insurance by less risk averse consumers can be reduced. If the demand reduction by less risk averse consumers is greater than the demand increase by more risk averse consumers, the total demand can be lower.¹²

APPLICATIONS TO THE INSURANCE MARKET**Catastrophic Events**

While insurance against catastrophic risks is not purchased widely, the occurrence of or news about catastrophic events leads to an increase in the insurance demand.¹³ Consider the attacks of September 11, 2001. The demand for travel and life insurance surged right after the attack.¹⁴ However, it is debatable whether or not the increase of demand can be justified by the increase of the risk. The reaction of demand to events can be great even if the events, in themselves, are not very informative regarding the

¹² For this, note that the purchase of insurance by consumer 1 initiates a 1-cascade among homogeneous a -consumers, while it may not among heterogeneous consumers.

¹³ Rare purchases of catastrophe insurance such as earthquake, flood, or terrorism insurance can be partially explained by a cascade effect, while it may also be affected by many other factors like high premiums and dependency of the risk.

¹⁴ CNN (10/09/2001) reported that the sales volume of travel insurance increased by 30 percent since the attack, even though the number of travelers decreased. CNN (11/09/2001) and *USA Today* (10/23/2001) reported that life insurance companies had seen an increase in business since September 2001. Similarly, Finance and Insurance News Service of Korea (11/15/2001) also reported that the demand for overseas travel insurance in Korea had increased by 30.9 percent in September 2001 and by 38.2 percent in October 2001 compared to the corresponding months of the year before. In one notable case, Samsung Fire & Marine Insurance observed increases of 73.3 percent in September and of 84.2 percent in October 2001.

risk.¹⁵ This point is also recognized in the media. For example, CNN (10/09/2001) wrote that “though the worst-case scenario is fresh in our minds, the reasons to buy, or not to buy, travel insurance are really no different than they’ve ever been.” In general, we often observe that the insurance demand surges right after a catastrophic event and then decreases back to its normal level over time (see Browne and Hoyt, 2000, for flood insurance; California Department of Insurance, 2002, for earthquake insurance).

The informational cascade theory may provide some intuitions for the demand over-reaction. Let us interpret the event as being public information H' . Based on our theory (Proposition 2), the public information can break a 0-cascade and can lead more consumers to purchase insurance, leading to a demand increase.¹⁶ Depending on the subsequent private information after the public information, a 1-cascade, a 0-cascade, or a no-cascade can be observed. Note that even if a 1-cascade is followed, it can be reversed by other public information (see Proposition 4). To show how it works, suppose that a 1-cascade is present after the public information broke a 0-cascade. Suppose also that no subsequent catastrophic event occurs for some period of time. No subsequent event for some period of time may also be interpreted as public information L' . As shown in Proposition 4, this public information L' may recover a 0-cascade, so that the demand decreases. As a result, demand may increase right after an event and decrease when there are no further events following. While the demand change may reflect the risk change, the cascade effects amplify the demand change.

Insurance Cycle

Our theory also has implications on the insurance cycle. The loss-shock theory states that a loss shock may lead to a price increase because the loss shock implies an increase of risk in the future or because external financing is costly. However, as criticized by Lai et al. (2000), a loss shock does not necessarily imply that future risks will increase to such a point to justify price increase under the discounted cash flow pricing. Pointing out problems in the loss-shock theory, Lai et al. emphasize the importance of demand-side effect on the cycle. They argue that the change in consumer’s expectation may contribute to the insurance cycle and market crisis. However, they do not provide how the expectations change.

Our theory connects a loss shock with the demand change. A loss shock (public information H') does not have to imply a large increase of risk. However, even a small increase of risk implied by a loss shock may break a 0-cascade, so that the demand can surge. When no loss shock occurs for an extended period of time, consumers interpret it as public information L' . Now, the demand may decrease. Even though a loss shock may not imply a large risk change, demand may change a lot. In this way, a loss shock affects demand that, in turn, contributes to the insurance cycle.

Election of Limited Tort Auto Insurance

Another example can be found in the choice of limited tort auto insurance in Pennsylvania (Regan, 2001). Policyholders in Pennsylvania were allowed to elect the limited

¹⁵ We do not argue that the attacks of September 11 are, in themselves, never informative regarding the risk. For our purpose, we need only to emphasize that the insurance demand surge is affected, at least partially, by factors other than the risk itself.

¹⁶ This phenomenon will occur more often if the insurance premium is not adjusted on time following the event.

tort system in 1990. Once they elect the limited tort system, the policyholders voluntarily give up the right to sue for noneconomic damages unless serious. The limited tort system was introduced in order to contain the increasing insurance costs and premiums under the traditional tort system. Regan (2001) finds that the highest limited tort election rates were among the urban areas and the lowest were among the rural areas in 1991.¹⁷ However, it changed in 1996. While the composition of the lowest counties was not changed, rural areas replaced some urban areas among the highest counties.¹⁸ This result was somewhat unexpected because the urban areas were thought to suffer more from insurance costs under the traditional tort system.

The informational cascade theory can explain this phenomenon. The policyholders are probably more homogeneous in the rural areas than in the urban areas. Our theory (Proposition 5) implies that the homogeneous policyholders in the rural areas tend to move in the same direction, more so than heterogeneous consumers in the urban areas.¹⁹ Therefore, it is not surprising that rural counties can be found among the highest counties as well as among the lowest counties.

CONCLUSION

We develop an informational cascade model based on BHW with applications to insurance demand. This article focuses on the effects of other policyholders' behavior and public information on the demand for insurance. We investigate how an informational cascade can exist and how public information affects the cascade. We apply our theory to the insurance market and find that our theory may provide intuitions as to how catastrophic events may lead to demand overreaction, how a loss shock may lead to an insurance cycle, and how informational cascade affects the choice of limited tort auto insurance in Pennsylvania.

Let us note the limitations of this article. While we have not distinguished between an information cascade and herding, herding does not necessarily result from an informational cascade (Smith and Sørensen, 2000; Çelen and Kariv, 2004). For example, herding can be observed because people receive the same signal. In addition, our model ignores some interesting aspects in communication. This article, like typical cascade models, assumes that individuals can only observe the actions of others. In reality, however, individuals communicate through diverse channels. For example, talks and actions are two important communication channels interacting with each other (Schotter, 2003; Çelen, Kariv, and Schotter, 2006; Gossner and Melissas,

¹⁷ The highest five counties included Philadelphia (50 percent), Bucks (41 percent), Montgomery (39 percent), Delaware (39 percent), and Chester (39 percent), while the lowest five counties included Luzerne (25 percent), Fayette (26 percent), Beaver (27 percent), Carbon (27 percent), and Lawrence (27 percent).

¹⁸ The highest five counties included Philadelphia (62 percent), Venango (54 percent), Bucks (51 percent), Wyoming (51 percent), and Sullivan (51 percent), while the lowest five counties included Luzerne (34 percent), Carbon (36 percent), Fayette (36 percent), Beaver (37 percent), and Lawrence (37 percent). The lowest five counties are not changed, but rural areas replaced urban areas among the highest five counties.

¹⁹ Even if the selection is not between insurance and no insurance here, it is not difficult to see that our theory can be applied to this case.

2006). Finally, individuals may not be fully rational in selecting actions. In this case, each individual needs to make inferences about others' rationality, which may not lead to a cascade even if others selected the same actions (Anderson and Holt, 1997; Goeree et al., 2007). The psychology literature generally points out the existence of primacy or recency effects, implying that people recall recent events more often than those from the past (Murdock, 1962; Ward, 2002). The recency effects can also explain the demand patterns after catastrophic events. To what extent demand changes can be attributed to informational cascades will be an interesting topic for future studies.

APPENDIX A: PROOFS

Proof of Proposition 1:

- (i) $P(0\text{-cascade begins with consumer } 2n + 2) = P(nL, nH, L, L) = (1/2)p^n(1 - p)^n[(1 - p)^2 + p^2]$. $P(\text{consumer } 2n + 2 \text{ is in a } 0\text{-cascade}) = \sum_{k=0}^n P(kL, kH, L, L) = (1/2)[(1 - p)^2 + p^2] \sum_{k=0}^n p^k(1 - p)^k = [(1 - p)^2 + p^2][1 - p^{n+1}(1 - p)^{n+1}]/2[1 - p(1 - p)]$.
- (ii) $P(1\text{-cascade begins with consumer } 2n + 1) = P(nL, nH, H) = (1/2)p^n(1 - p)^n[(1 - p) + p] = (1/2)p^n(1 - p)^n$. $P(\text{consumer } 2n + 1 \text{ is in } 1\text{-cascade}) = \sum_{k=0}^n P(kL, kH, H) = (1/2)[(1 - p)^2 + p^2] \sum_{k=0}^n p^k(1 - p)^k = [1 - p^{n+1}(1 - p)^{n+1}]/2[1 - p(1 - p)]$.
- (iii) $P(\text{consumer } 2n + 2 \text{ is in no-cascade}) = P(nL, nH, L, H) = p^{n+1}(1 - p)^{n+1}$. $P(\text{consumer } 2n + 1 \text{ is in no-cascade}) = P(nL, nH, L) = p^n(1 - p)^n/2$.
- (iv) Obvious. □

Proof of Proposition 2

- (i) Suppose that a 0-cascade is present, which implies that (LL) can be inferred from the previous consumers. Now, suppose that public information S' is announced. If $s = 1$, then for any n , $P(g | S' nL) = v_{S'}$ where $v_{S'} = 1$ with $S' = H'$ and $v_{S'} = 0$ with $S' = L'$. Thus, the probability of loss with information $(S'nL)$ is the same as that with information S' only. By assumption, the consumer with no private information will purchase insurance. Thus, the 0-cascade is broken. Now suppose that $s < 1$ and that $n = n^*$ is the minimum number of L s, such that the consumers with information (S'_nL) do not purchase insurance. If $n^* > 3$, then the 0-cascade is always broken, because the first consumer after the public information is announced will have information of $(S'LLL)$ or $(S'LL)$, thus purchase insurance. For $n^* = 2$ or 3 , if one of the new $n^* - 1$ consumers receives H , then the 0-cascade is broken (as in the text above Proposition 2). For $n^* = 1$, the 0-cascade is not broken because the new consumer with $(S'LLL)$ or $(S'LL)$ will not purchase insurance.
- (ii) We prove this by an example in Appendix B. In the mean-variance model of Appendix B, (B1) and (B3) represent the conditions for consumers with $(H'L)$ and $(L'L)$ to purchase insurance, respectively. Suppose that the insurance premium is actuarially fair, or $\lambda = 0$. Now (B1) and (B3) become

$$[(2p-1)(g-b)s(1-s)]^2 < a^2[\{g(1-p)-bp\}s+bp] \\ \times [\{(1-g)(1-p)-(1-b)p\}s+(1-b)p] \quad \text{and} \quad (A1)$$

$$[(2p-1)(g-b)s(1-s)]^2 < a^2[\{g(1-p)-bp\}s-g(1-p)] \\ \times [\{(1-g)(1-p)-(1-b)p\}s-(1-g)(1-p)]. \quad (A2)$$

Note that a is the risk aversion factor of the consumer. Note that the left-hand sides (LHSs) of both formulas are identical. At $s = 1/2$, the right-hand sides (RHSs) of both formulas have the same value of $(a^2/4)[g(1-p)+bp][(1-g)(1-p)+(1-b)p]$. When $g(1-p) < bp$, the RHS of (A1) is decreasing and the RHS of (A2) is increasing for $1/2 < s < 1$. Thus, the RHS of (A2) $>$ the RHS of (A1). This implies that there exists s between $1/2$ and 1 such that a 0-cascade is broken with L' , not with H' . By continuity, the above result applies for small positive λ . $\square$

Proof of Proposition 5: We prove the proposition in a more general setting.

(i) Let us call information K critical information for one type of consumer, if one of the following holds:

- (a) He will purchase insurance with K , but not with KL and
- (b) He will purchase no insurance with K , but with KH .

As the treatment is symmetric, we focus only on case (a). Suppose that M and N are the critical information for a-consumer and for A-consumer, respectively. As A-consumers are more inclined to purchase insurance, N includes more (net) L s than M does. For notational convenience, let us define the ordering among information, $>(\geq)$, with respect to the number of L s included as follows: $N > (\geq) M$ if N has strictly (weakly) more L s than M does. With this notation, we assume $N > M$. We consider the decision making of consumer n where information K is inferred from previous consumers. For information $K < M$ or $K \geq NLL$, the behavior of two types of consumers is identical, because both consumers will purchase insurance ($K < M$) or no insurance ($K \geq NLL$) with any private information. In addition, if $ML < K < N$, then an A-consumer will purchase insurance and an a-consumer will never purchase insurance, regardless of their private information. Thus, a-consumer's behavior is not affected by the existence of other type of consumers for $K < M$, $ML < K < N$, or $K \geq NLL$. Thus, the effect of heterogeneous types, if any, can be found only for $M \leq K \leq ML$ or $N \leq K \leq NL$.

Now, suppose $K = M$. If the consumer n receives $H(L)$, then his information becomes $MH(ML)$. Thus, if the consumer n is type a, then he will purchase insurance (no insurance) when he receives $H(L)$. On the other hand, if the consumer is type A, then he will always purchase insurance. Therefore, when consumer n does not purchase insurance, then he must be type a, while he can be either type if he purchases insurance. Thus, consumer $n+1$ will calculate the probability that $R = g$, given consumer n 's behavior and $K = M$ as

$$P(g|M1) = P(n=A|B_n=1, M)P(g|M) + P(n=a|B_n=1, M)P(g|MH), \\ P(g|M0) = P(g|ML).$$

Note that if there are only a-consumers, then we would have $P(g | M1) = P(g | MH)$. (Note that $P(g | M1)$ is smaller when the population of A-consumers is higher, because $P(n = A | B_n = 1, M)$ is higher then.) As $P(g | M1) \leq P(g | MH)$, consumer $n + 1$ will have information indicating weakly lower probability that $R = g$ under heterogeneous case than in the homogeneous case in which all consumers are type a.

Now, suppose that $K = ML$. Applying the same logic as above, consumer $n + 1$ will calculate the probability that $R = g$, given n 's behavior and $K = ML$ as

$$\begin{aligned} P(g | ML1) &= P(n = A | B_n = 1, ML)P(g | ML) \\ &\quad + P(n = a | B_n = 1, ML)P(g | MLH) \quad \text{if } N > ML, \\ P(g | ML1) &= P(g | MLH) \quad \text{if } N = ML, \\ P(g | ML0) &= P(g | MLL). \end{aligned}$$

Note that if $N = ML$, then an A-consumer will also respond to the private information exactly as an a-consumer. Thus, when consumer n purchases insurance, it transfers H for both types. If there are only a-consumers, then we would always have $P(g | ML1) = P(g | MLH)$. As $P(g | ML1) \leq P(g | MH)$, consumer $n + 1$ will have information indicating weakly lower probability that $R = g$ under the heterogeneous case than in the homogeneous case in which all consumers are type a.

In sum, a-consumers are more inclined to purchase no insurance under the heterogeneous case than in the homogeneous case in which there are only a-consumers. For $K = N$ or NL , the same logic above applies and we can show that A-consumers are more inclined to purchase insurance under the heterogeneous case than in the homogeneous case in which there are only A-consumers. Finally, note that $M = 0$ and $N = LL$ in our model in the text.

- (ii) It follows from the observation in the proof of (i) that $P(g | M1)$ and $P(g | ML1)$ is weakly smaller when the population of A-consumers is higher because $P(n = A | B_n = 1, M)$ is higher then.

APPENDIX B: A MEAN-VARIANCE MODEL

Assume that the consumer's expected utility can be denoted as follows:

$$V = E(\text{wealth}) - a\sigma = W - qX - a\{q(1 - q)\}^{1/2}X,$$

where W is the initial wealth, a is the risk aversion factor, σ is the standard deviation of the wealth, and q is the subjective probability of loss. When the consumer purchases (full) insurance with premium e , his expected utility becomes $W - e$. Therefore, the consumer will purchase insurance iff $e < e^*(q) \equiv qX + a\{q(1 - q)\}^{1/2}X$.

Suppose that the public information, S' , is known before the first consumer's decision. The insurance premium is set based on public information: $e = (v_{S'} + \lambda)X$, where $v_{S'} = gP(g | S') + bP(b | S')$ is the probability of loss given S' and λ is a loading factor. For $e = (v_{S'} + \lambda)X$, a consumer will purchase insurance iff $v_{S'} + \lambda < q + a\{q(1 - q)\}^{1/2}$. Note that $v_{S'} = q$ when the consumer has no private information. In this case, the consumer will purchase insurance if and only if $\lambda < a\{q(1 - q)\}^{1/2}$. We assume that

$\lambda < a\{b(1-b)\}^{1/2}$, so that the consumer with no private information will purchase insurance.

Note that q is decreasing (increasing) with the number of private information L (H). In addition, $q(1-q)$ is increasing in q for $q < 1/2$. In most cases in the insurance market, it is reasonable to assume that $g < 1/2$, thus, $q < 1/2$. Under this assumption, if the consumer's information includes more L s (H s), then q and $q(1-q)$ decrease (increase), *ceteris paribus*.

Now let us investigate the possibility of public information in breaking a cascade. Recall that when there is no public information, two consecutive L initiates a 0-cascade and one H initiates a 1-cascade, after no information. Note also that no public information corresponds to $s = 1/2$.

With no public information, the consumer with information L should not purchase insurance. Now suppose $S' = H'$ and consider a consumer with $H'L$. The subjective probability of loss, q , becomes

$$\begin{aligned} q &= v_{H'L} = gP(g | H', L) + bP(b | H', L) \\ &= [gs(1-p) + b(1-s)p] / [s(1-p) + (1-s)p]. \end{aligned}$$

Thus, the consumer will purchase insurance iff $gs + b(1-s) + \lambda < [gs(1-p) + b(1-s)p] / [s(1-p) + (1-s)p] + a\{[gs(1-p) + b(1-s)p][(1-g)s(1-p) + (1-b)(1-s)p]\}^{1/2} / [s(1-p) + (1-s)p]$.

Arranging the formula gives

$$\begin{aligned} &[-(2p-1)(g-b)s^2 + (2p-1)(g-b-\lambda)s + \lambda p]^2 \\ &< a^2\{[g(1-p) - bp]s + bp\}[(1-g)(1-p) - (1-b)p]s + (1-b)p. \quad (B1) \end{aligned}$$

For consumer with information $H'LL$, we have that $v'_{H'LL} = [gs(1-p)^2 + b(1-s)p^2] / [s(1-p)^2 + (1-s)p^2]$.

The consumer will purchase insurance iff

$$\begin{aligned} &gs + b(1-s) + \lambda < \{[gs(1-p)^2 + b(1-s)p^2] + a\{[gs(1-p)^2 + b(1-s)p^2] \\ &\quad \times [(1-g)s(1-p)^2 + (1-b)(1-s)p^2]\}^{1/2}\} / [s(1-p)^2 + (1-s)p^2]. \end{aligned}$$

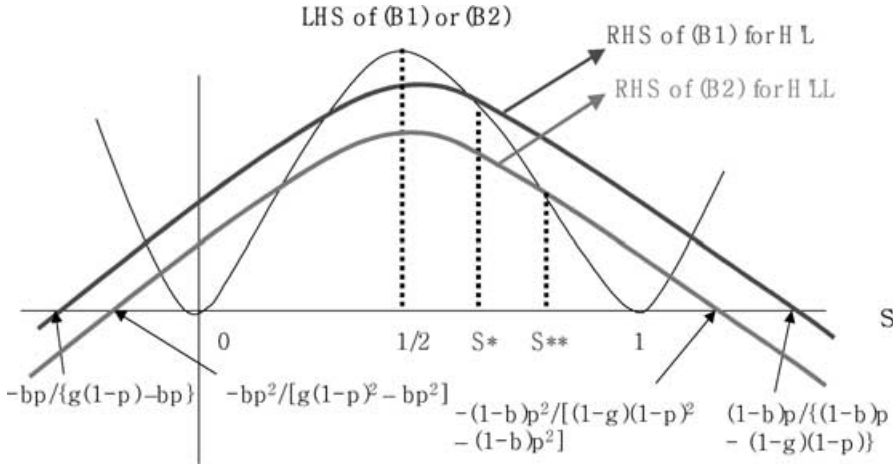
Arranging it gives

$$\begin{aligned} &[-(2p-1)(g-b)s^2 + (2p-1)(g-b-\lambda)s + \lambda p^2]^2 \\ &< a^2\{[g(1-p)^2 - bp^2]s + bp^2\}[(1-g)(1-p)^2 - (1-b)p^2]s + (1-b)p^2. \quad (B2) \end{aligned}$$

Each LHS of (B1) and (B2) is the 4th degree polynomial of s with a W-shape. Each RHS is the 2nd degree polynomial of s . The RHS can be of U-shape or of reverse U-shape

FIGURE B1

The Effects of Public Information H' for $s^* < s < s^{**}$, a Consumer With H'/L Purchases Insurance While a Consumer With H'/LL Purchases No Insurance



depending on the values of p , g , and b . Each equation of $LHS = 0$ of (B1) and (B2) has one (weakly) negative root and one positive root (weakly) greater than 1.

Let s^* be a solution of (B1) with equality and s^{**} be a solution of (B2) with equality, where $1/2 \leq s^* < s^{**} \leq 1$. (To show the existences of such s^* and s^{**} is easy and omitted here.) A consumer with H'/L will purchase insurance for $s \geq s^*$ and a consumer with H'/LL will purchase insurance for $s \geq s^{**}$. For $s^* < s < s^{**}$, a consumer with H'/LL does not purchase insurance, but a consumer with H'/L purchases insurance. Figure B1 depicts s^* and s^{**} for actuarially fair premium, $\lambda = 0$. Note that LHSs of (B1) and (B2) become identical with $\lambda = 0$.

Breaking a 0-Cascade

Now, let us illustrate how public information destroys a 0-cascade. Suppose that no public information is revealed yet and a 0-cascade is present. This implies that a new consumer will learn only LL from previous consumers. The new consumer will not purchase insurance when he receives H . However, suppose that the public information H' is revealed just before he decides and $s^* < s$.²⁰ Now the consumer has information of $H'LLH = H'/L$. Based on the discussion above, the consumer will purchase insurance. Thus, the 0-cascade is broken.²¹

Even if the public information breaks a cascade, it does not mean its effect should last long. For this, suppose that $s^* < s < s^{**}$. If the next consumer receives H , then a

²⁰ If $s < s^*$, then the 0-cascade will not be broken.

²¹ We note that the public information does not necessarily break the 0-cascade. For example, if $S' = H'$ is revealed just before a consumer with L , not H , then the consumer has information of $H'LL$ and will not purchase insurance. In this case, the 0-cascade sustains because the next consumer with H will not purchase insurance.

1-cascade begins. On the other hand, if the next two consumers receive L , then the 0-cascade is recovered. Of course if the consumers receive L and H in turn, then no new cascade begins yet.

When the public information $S' = L'$, we can apply the same logic as in the case of $S' = H'$. For consumers with $L'L$ and with $L'LL$, the conditions for insurance purchase are obtained as follows:

$$[-(2p-1)(g-b)s^2 + (2p-1)(g-b+\lambda)s + \lambda(1-p)]^2 < a^2\{[g(1-p)-bp]s - g(1-p)[(1-g)(1-p) - (1-b)p]s - (1-g)(1-p)\}. \quad (B3)$$

$$[-(2p-1)(g-b)s^2 + (2p-1)(g-b-\lambda)s + \lambda(1-p)^2]^2 < a^2\{[g(1-p)^2 - bp^2]s - g(1-p)^2[(1-g)(1-p)^2 - (1-b)p^2]s - (1-g)(1-p)^2\}. \quad (B4)$$

By applying the same logic to (B3) and (B4) as in the case of $S' = H'$, we can obtain the range of s for breaking the 0-cascade and the effects of the public information, which will not be repeated here.

REFERENCES

- Anderson, L. R., and C. A. Holt, 1997, Information Cascades in the Laboratory, *American Economic Review*, 87(5): 847-862.
- Banerjee, A. V., 1992, A Simple Model of Herd Behavior, *Quarterly Journal of Economics*, 107(3): 797-817.
- Banerjee, A. V., 1993, The Economics of Rumours, *Review of Economic Studies*, 60(2): 309-327.
- Berger, L. A., P. R. Kleindorfer, and H. Kunreuther, 1989, A Dynamic Model of the Transmission of Price Information in Auto Insurance Markets, *Journal of Risk and Insurance*, 56(1): 17-33.
- Bikhchandani, S., D. Hirshleifer, and I. Welch, 1992, A Theory of Fads, Fashion, Custom and Cultural Change as Informational Cascades, *Journal of Political Economy*, 100(5): 992-1026.
- Brown, J. J., and P. H. Reingen, 1987, Social Ties and Word-of-Mouth Referral Behavior, *Journal of Consumer Research*, 14(3): 350-362.
- Browne, M. J., and R. E. Hoyt, 2000, The Demand for Flood Insurance: Empirical Evidence, *Journal of Risk and Uncertainty*, 20(3): 291-306.
- California Department of Insurance, 2002, News: Earthquake Coverage Experience Five Year Trend, <http://www.insurance.ca.gov/0400-news/0200-studies-reports/0300-earthquake-study/1996-2000/index.cfm> (Revised 10/4/02).
- Çelen, B., and S. Kariv, 2004, Distinguishing Informational Cascades From Herd Behavior in the Laboratory, *American Economic Review*, 94(3): 484-498.
- Çelen, B., S. Kariv, and A. Schotter, 2006, An Experimental Test of Advice and Social Learning, Working Paper, University of California, Berkeley.

- CNN, 2001a, Is Travel Insurance Worth It? October 9, http://money.cnn.com/2001/10/09/insurance/travel_insurance/index.htm.
- CNN, 2001b, Consumers Seek Comfort, November 9, http://money.cnn.com/2001/11/09/saving/q_consumer/index.htm.
- D'Arcy, S. P., and P. Oh, 1997, The Cascade Effect in Insurance Pricing, *Journal of Risk and Insurance*, 64(3): 465-480.
- Dodson, J. A. Jr., and E. Muller, 1978, Models of New Product Diffusion Through Advertising and Word-of-Mouth, *Management Science*, 24(15): 1568-1578.
- Doherty, N. A., and S. H. Seog, 2000, A Dynamic Model of the Coexistence of Distribution Systems: An Insurance Example, *Singapore International Insurance and Actuarial Journal*, 4(1): 19-36.
- Finance and Insurance News Service, 2001, Mi Terror Satae Ihu Yeohaengja Bohum Gaip Keup Jeung [Surge in Travel Insurance Since the Attack on the USA], November 15, <http://www.fins.co.kr>.
- Froot, K. A., D. S. Scharfstein, and J. C. Stein, 1992, Herd on the Street: Informational Inefficiencies in a Market with Short-Term Speculation, *Journal of Finance*, 47(4): 1461-1484.
- Goeree, J. K., T. R. Palfrey, B. W. Rogers, and R. D. McKelvey, 2007, Self-Correcting Information Cascades, *Review of Economic Studies*, 74(3): 733-762.
- Gossner, O., and N. Melissas, 2006, Informational Cascades Elicit Private Information, *International Economic Review*, 47(1): 297-325.
- Lai, G. C., R. C. Witt, H.-G. Fung, R.D. MacMinn, and P. L. Brockett, 2000, Great (and Not so Great) Expectations: An Endogenous Economic Explication of Insurance Cycles and Liability Crises, *Journal of Risk and Insurance*, 67(4): 617-652.
- Mahajan, V., E. Muller, and F. M. Bass, 1990, New Product Diffusion Models in Marketing: A Review and Directions for Research, *Journal of Marketing*, 54(1): 1-26.
- Murdock, B. B., Jr., 1962, The Serial Position Effect of Free Recall, *Journal of Experimental Psychology*, 64(5): 482-488.
- Regan, L., 2001, Determinants of the Selection of Limited Tort Auto Insurance in Pennsylvania: An Empirical Analysis, in: E. J. Lascher and M. R. Powers, eds., *The Economics and Politics of Choice No-Fault Insurance* (Boston: Kluwer Academic Publishers).
- Reingen, P. H., and J. B. Kernan, 1986, Analysis of Referral Networks in Marketing: Methods and Illustration, *Journal of Marketing Research*, 23(4): 370-378.
- Scharfstein, D. S., and J. C. Stein 1990, Herd Behavior and Investment, *American Economic Review*, 80(3): 465-479.
- Schotter, A., 2003, Decision Making with Naive Advice, *American Economic Review*, 93(2): 196-201.
- Seog, S. H., 1999, The Coexistence of Distribution Systems When Consumers Are Not Informed, *Geneva Papers on Risk and Insurance Theory*, 24(2): 173-192.
- Smith, L., and P. Sørensen, 2000, Pathological Outcomes of Observational Learning, *Econometrica*, 68(2): 371-398.
- Taylor, S. A., 2001, Assessing the Use of Regression Analysis in Examining Service Recovery in the Insurance Industry: Relating Service Quality, Customer

Satisfaction, and Customer Trust, *Journal of Insurance Issues*, 24(1&2): 30-57.

USA Today, 2001, November 22, <http://www.usatoday.com/money/columns/block/2001-10-23-block.htm>.

Ward, G., 2002, A Recency-Based Account of the List Length Effect in Free Recall, *Memory and Cognition*, 30(6): 885-892.

Welch, I., 1992, Sequential Sales, Learning and Cascades, *Journal of Finance*, 47(2): 695-732.

Copyright of Journal of Risk & Insurance is the property of Blackwell Publishing Limited and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.