Marine Resource Economics, Volume 26, pp. 281–291
Printed in the U.S.A.
0738-1360/00 $3.00 + .00

When Diseases Hit Aquaculture: An Experimental Study of Spillover Effects from Negative Publicity

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Abstract *Aquaculture, as all animal production, is exposed to diseases which can cause negative publicity and market impacts. A recent example is the Chilean salmon farming industry, which is currently facing unprecedented economic losses due to an outbreak of infectious salmon anemia. We conducted two consumer experiments to investigate spillover effects of negative publicity on consumer valuation of seafood products from unaffected countries and species, as well as a potential mitigating strategy that an affected industry might use. We find significant negative spillover effects on the same species produced in unaffected countries and on other fish species farmed within the affected country. We also find that building a brand association with an upscale retailer does not improve the consumer valuation (*i.e.*, no positive spillover effects) for products from directly and indirectly affected countries of the affected species.*

Key words Salmon, disease outbreak, spillover, experiments, negative publicity.

JEL Classification Codes Q13, Q22.

Introduction

Aquaculture, as all animal production, is exposed to diseases which can cause negative publicity and market impact. A recent example is the Chilean salmon aquaculture industry, which experienced the worst disease outbreak ever observed in salmon aquaculture and, in terms of revenue losses, possibly the worst in aquaculture's history (Asche *et al*. 2009). The disease, infectious salmon anemia (ISA) was first reported in Chile in 2007, and reports of new outbreaks have increased rapidly through 2009. Because of the production cycle for salmon, the full impact of the disease will not be fully realized until 2010. Even so, the numbers currently being reported are dramatic, and production of Atlantic salmon in Chile was reduced to 130,000 tonnes in 2010, down from 385,000 tonnes in 2005. While the eruption of the disease obviously has had serious direct economic effects on the Chilean salmon industry, there may also be some indirect effects as a result of the loss of consumer confidence. For example, the disease outbreak may be viewed as a result of poor management practices, which may lead consumers to perceive Chilean seafood to be of lower quality or less safe than products from other countries. Moreover, if consumers believe that similar underlying problems that caused the Chilean outbreak prevail in other countries or with other aquaculture practices, such negative effects may carry over beyond the Chilean salmon market and influence

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Funding for the project was provided by the Faculty of Social Sciences and the Food Market Research Program, University of Stavanger. The authors thank Frank Asche for all his help during the preparation of this article.

consumers' perceptions about products from other countries and species that are not directly affected by the ISA outbreak.[1]

These indirect effects are referred to as "spillover effects" in the consumer psychology literature, and they are defined as the extent to which information provided in a message alters consumers' beliefs about attributes that are not mentioned in that message (Ahluwalia, Unnava, and Burnkrant 2001). Spillover effects have received increasing attention among marketers and consumer researchers in recent years, and they have been studied in a variety of contexts, such as between attributes, between products, and between brands (*e.g.*, Ahluwalia, Unnava, and Burnkrant 2001; Balachander and Ghose 2003; Janakiraman, Sismeiro, and Dutta 2009).

The accessibility-diagnosticity framework developed by Feldman and Lynch (1988) is often employed as a general starting point to illustrate spillover effects. Roehm and Tybout (2006) discuss how this general framework can be applied to explain such effects: "if Brand A is perceived as being informative about (or diagnostic for) brand B, observations about brand A will be inferred to apply to brand B, provided that Brand A, Brand B, and the observations are all activated at the same time." Applied to our context, this implies that, if the negative information consumers receive about the salmon disease outbreak in Chile is perceived to be informative about salmon from others countries (*i.e.*, the association is drawn within the same species), then the negative perception of Chilean salmon will be extended to salmon products in general. On the other hand, if consumers diagnose the negative publicity as informative of Chilean aquaculture rather than of specific species of fish (*i.e.*, the association is drawn within the same country), then the spillover will be extended to other species of farmed fish in Chile. We refer to the former effect as the "within-species" effect and the latter as the "within Country-of-Origin" (CoO) effect.

If the negative publicity of a disease outbreak in aquaculture directly or indirectly affects consumer valuations, marketers should examine the kinds of coping strategies that might be effective in persuading consumers to buy the products, despite the negative association. Obviously, the first strategic move should be to remove the occurrence of the disease, but there might be other actions that could prove beneficial should an outbreak of a disease (or other events that result in negative publicity) materialize in the future. One potential strategy may be to use the spillover effect to an advantage by building a brand association with a partner who possesses a strong and positive reputation (Schiffman, Kanuk, and Hansen 2008). In particular, an alliance with an importer or retailer that holds an upscale and strong brand image may mitigate the negative publicity effects.

The aforementioned spillover effects are highly relevant to seafood marketing; however, such effects have not been fully explored. In this article, we aim to begin filling the knowledge gap by analyzing spillover effects using data from two consumer experiments. The first experiment focuses on the two types of spillover effects resulting from negative publicity of a disease outbreak. The second experiment examines whether the positive image of an upscale, high-quality retailer can mitigate the effects of negative publicity.

Salmon is a natural candidate to use in an experiment, as salmon together with shrimp are the most successful aquaculture species. Together these species make up about 30% of the production value in aquaculture (Asche and Bjørndal 2011). This development has been possible due to a control with the production process that has allowed innovations in production technology and marketing (Tveteras 2000, 2002; Anderson 2002; Asche 2008; Asche, Roll, and Tveteras 2009). However, the nature of the production process in aquaculture has also led to environmental interactions (Tveterås 2002) that have possibly also influenced consumer perceptions (Chu *et al*. 2010).

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[1] Much of the media covering the Chilean ISA outbreak has blamed farming practices as a primary cause of the outbreak. They have also portrayed the aquaculture industry as a source of negative environmental externalities, such as a high rate of antibiotic use, water pollution from fish feed, and negative effects of escaped fish to natural stocks (*e.g.*, Barrionuevo 2008).

Experiment 1: Within-Country and Within-Species Spillover Effects from Negative Publicity

The first experiment focuses on negative spillover effects to other species and from one foreign origin to another. Hence, the following two hypotheses are at the center of attention in Experiment 1:

> H1: Among consumers, the negative effects of an outbreak of salmon disease will spill over to other unaffected species of fish originating from the same country (the within-CoO effect).
>
> H2: Among consumers, the negative effects of an outbreak of salmon disease will spill over to salmon from other countries unaffected by the disease (the within-species effect).

Both fish species and CoO have been found to be important when consumers choose seafood products (*e.g.*, Jaffry *et al.* 2004; Johnston and Roheim 2006; Uchida *et al*. 2010). CoO effects have been extensively studied in the marketing literature, which document significant effects in a variety of product categories, ranging from chocolate (Camgoz and Ertem 2008) and wine (Aqueveque 2008) to personal computers (Pecotich and Ward 2007). The importance of CoO tends to increase when it is either impossible or difficult for consumers to directly observe product quality. For example, when purchasing seafood products, consumers may care about experience or credence attributes such as freshness, taste, food safety, and sustainability (*e.g*., Wessells 2002), but they will normally find it difficult, if not impossible, to judge these quality dimensions at the point of purchase (Hansen and Sallis 2011). Instead, consumers are likely to rely on other secondary quality signals, such as CoO or brand image. The specific fish species is a primary quality aspect of the fish product that consumers can usually observe at the time of the purchase. However, fish species can convey a variety of information to consumers, as particular species typically have high correlation with eating quality (*e.g.*, taste and texture) and food safety (*e.g.*, expected mercury level). Provided that both CoO and fish species may be used as proxies for some underlying unobservable quality characteristics of a fish product, a negative shock, such as a disease outbreak, may spill over within the same country to unaffected species and/or within the same species to unaffected countries.

Experiment 1 was designed to test whether a large outbreak of fish disease in one species in one country would influence consumer judgments of: *i)* other fish species imported from that country and *ii)* imported fish of the same species from another country where no such outbreak occurred. Two consumer-related measures are selected as dependent variables to test the hypotheses: purchase intention and perceived product quality. These dependent variables collectively cover two important aspects of product judgments: a quality judgment based on cognitive evaluations and behavioral measures of intentions towards the product (Schiffman, Kanuk, and Hansen 2008). An experiment with a 2 × 2 between-subjects factorial design was created. We chose to construct the treatments in the form of a newspaper article because this is a common way that consumers are exposed to information regarding a disease outbreak. The first experimental factor tests the within-CoO effect. Here, half of the participating subjects were told that a new salmon product was being introduced to the domestic market by a large supermarket chain under its private label and that the product was imported from a country that had experienced serious problems with a salmon disease (Chile). The other half were offered the same cover story, but here the product in question was tilapia. Both story variations included a section on the outbreak of salmon disease in Chile to ensure the presence of all the aspects necessary to comply with the requirements of the accessibility-diagnosticity framework. Hence, one group was informed of a new salmon product from Chile where the farming industry had suffered severely from the salmon

disease, but the importer guarantees the product to be safe. The second group received the exact same information, except that the product was farmed tilapia.[2]

The second experimental factor was set up to test whether an effect of a country experiencing an outbreak of the salmon disease would influence consumer perceptions of the same species imported from another country; that is, the within-species effect. For this experiment, Canada was selected as the source unaffected by the disease outbreak. In the first story variation, the fish was either salmon or tilapia, and in the second, the fish was either from Chile or Canada, creating a total of four experimental cells (salmon/tilapia × Chile/Canada).

Purchase intentions were measured with reworded versions of the repurchase scale reported by Kumar, Hibbard, and Stern (1994) and Hansen, Sandvik, and Selnes (2003). The items for perceived product quality were self constructed, but they were largely inspired by Zeithaml, Berry, and Parasuraman (1996). All scales were in a seven-point Likert-type format, with the anchors being strongly disagree (1) and strongly agree (7). The validity of these response measures was pre-tested using both expert inputs and in-person interviews with consumers. No changes were made to the items after these procedures. A total of 194 university students were recruited as participants in the experiment, and they were randomly allocated to the four experimental conditions.

Data Analysis

The multi-item scales were subject to validation by means of an exploratory factor analysis with maximum likelihood extraction and Direct Oblimin rotation. The factor scores for purchase intentions were between 0.731 and 0.882, and the perceived quality scale received loadings from 0.690 to 0.709. Scale reliability was assessed with Cronbach's alpha, with values of 0.866 for purchase intention and 0.728 for perceived quality. The factor loadings and Cronbach's alpha values are reported in table 1.

Table 1
Factor Loading Scores and Reliability Measures (Exp. 1)

Item	Factor Loading	Cronbach's Alpha
Purchase intention 1	0.882	0.866
Purchase intention 2	0.870	
Purchase intention 3	0.731	
Perceived quality 1	0.709	0.728
Perceived quality 2	0.690	
Perceived quality 3	0.697	

The two multi-item measures for the dependent variables were then summarized to index variables. The mean scores in the total sample were 4.38 (sd=1.84) for purchase intention and 4.11 (sd=1.24) for perceived quality. The mean scores for the two dependent variables are reported across the four experimental conditions (table 2). The hypotheses tests were based on a multivariate analysis of variance (MANOVA), and the results are reported in table 3. The effects on purchase intention are marginally significant for within CoO (F=3.095, p=0.08), while the within-species effect is highly significant (F=9.067, p=0.003). In terms of perceived product quality, there is a significant effect of both within CoO (F=23.922, p=0.000) and within species (F=4.267, p=0.040). The two-way interaction between CoO and species has no significant effect on either purchase intention (F=1.342) or perceived quality (F=0.359).

[2] We are, of course, aware that tilapia is not actually farmed in Chile and that production in Canada is limited. However, for the experiment setting this is not an important caveat. Norman-López (2009) provides a discussion of the tilapia market.

Table 2
Means (Standard Deviation) Across Experimental Conditions (Exp. 1)

	Salmon	Tilapia	Within-condition Means
CoO with salmon disease (Chile)	PI: 3.61 (1.76) PQ: 3.59 (1.26)	PI: 4.70 (1.66) PQ: 3.82 (1.28)	PI: 4.15 (1.79) PQ: 3.70 (1.27)
CoO without salmon disease (Canada)	PI: 4.36 (1.97) PQ: 4.30 (0.99)	PI: 4.85 (1.75) PQ: 4.75 (1.09)	PI: 4.61 (1.87) PQ: 4.53 (1.06)
Within-condition means	PI: 3.97 (1.89) PQ: 3.93 (1.19)	PI: 4.77 (1.70) PQ: 4.29 (1.27)	

PI: purchase intention; PQ: perceived quality.

Table 3
Hypotheses Test Results: Multivariate Analysis of Variance (Exp. 1)

		Purchase Intention F-value	Perceived Quality F-value
Main effect	Country of origin	3.095^{*}	23.922^{***}
	Species of fish	9.067^{***}	4.267^{**}
Interaction effect	CoO × Species	1.342	0.359

Significance levels: $^{*}\ p \leq 0.1$, $^{**}\ p \leq 0.05$, $^{***}\ p \leq 0.01$.

Discussion

As expected, the species and country directly affected by the disease outbreak (Chilean salmon) exhibit the lowest values for purchase intention and perceived quality among the four experimental variations. However, our primary interest is to assess the spillover effects, and the results clearly show that such effects occur when consumers are exposed to information about the disease outbreak. The difference in perceived quality between Canadian tilapia and Chilean tilapia (4.75 vs. 3.82) is highly significant, as is the difference in perceived quality between Canadian tilapia and Canadian salmon (4.75 vs. 4.30), both of which indicate that consumers perceive the news of a disease outbreak as a quality indicator of different fish species from the same country as well as of the same fish species from different countries. However, the spillover effects seem to affect the purchase intentions differently for different species. Even though consumers reported a significantly lower perceived quality for Chilean tilapia, the mean purchase intention for Chilean tilapia is not that different from that of Canadian tilapia (4.70 for Chile vs. 4.85 for Canada), and it is higher than that of Canadian salmon (4.30). On the other hand, the perceived quality of salmon products almost parallels purchase intention. The fact that perceived quality translates into purchase intention in a straightforward manner for salmon but not so strongly for tilapia is somewhat unexpected, and it may suggest that other unaccounted factors are at work. For example, Chilean tilapia may be considered to be bargain—it may be of lower quality, but it also may have an attractive price.

The results also suggest that the constituents who should be most worried by a disease outbreak are farmers producing the same species as the infected one, even if they

are located in foreign countries unaffected by the disease. In terms of the theoretical framework, this indicates that consumers may perceive higher levels of diagnosticity at the species level than the country level. Stated differently, ISA-infected Chilean salmon is more representative of farmed salmon in general than it is of Chilean fish in general.

Experiment 2: The Mitigating Effect of Store Reputation

Given the fact that both direct and indirect spillover effects were found in Experiment 1, it is important for marketers to consider the types of strategies that can be used to mitigate the effects of negative publicity. One possibility is to build on the concept of brand association by cooperating with a partner who has a strong and positive reputation (Schiffman, Kanuk, and Hansen 2008). Previous studies have documented a transfer of attitudes between brands and causes, especially within the area of sponsoring and cause-related marketing, such as corporate social responsibility. Typically, a brand or firm can benefit from the positive association consumers hold toward a cause by pointing out their relationship with the cause (Lafferty and Goldsmith 2005). In Experiment 2, we empirically test whether an alliance with an importer/retailer that holds an upscale, strong brand image will mitigate the lower consumer valuation from negative publicity. The second experiment is, therefore, designed to test the following hypothesis:

> H3: The effects from negative publicity can be mitigated by a positive spillover effect from an upscale retail store for which consumers have strong quality perceptions.

We employ two existing national supermarket chains as a treatment. One chain is considered to be upscale and has a general reputation of carrying high quality food; the other is known for offering low-price products that are also perceived to be of lower quality. Again we created an experiment with a 2 × 2 between-subjects factorial design, with country (Chile vs. Canada) and supermarket chains (upscale vs. discount) as the two factors. The same information format (newspaper article) and measures of consumer valuations (purchase intention and perceived product quality) were used. However, only salmon products were considered in this experiment. Thus, the experimental design included four different versions of the cover story, with varied combinations of product origin and retailer. Although this experiment was administered independent of the first experiment, the two experiments share the same baseline story. In the first experiment, the importing supermarket chain was profiled in the second experiment as the discount store. Hence, the salmon scenarios in the first experiment were conceptually equal to the discount supermarket cells in the second experiment.

A questionnaire similar to that used in Experiment 1 was administered to participants. In this experiment, however, participants were taken from a sampling of the general Norwegian population. A web-based survey was administered by a third-party professional market research firm. Invitations were sent to the national panel that the firm maintains, which resulted in 216 usable responses. Each respondent was randomly assigned to one of the four treatments.

Data Analysis

The scale validation procedure in Experiment 2 was the same as that employed in Experiment 1. Table 4 summarizes factor loadings and Cronbach's alpha values. The factor scores for the purchase intention items were between 0.756 and 0.0932, while the scores for perceived product quality ranged from 0.577 to 0.909. Cronbach's alpha values were 0.748 for purchase intention and 0.881 for product quality. The means for the two sum-

marized indexes for the dependent variables were 3.72 (sd=1.73) and 3.88 (sd=1.17) for purchase intention and product quality, respectively.

Table 4
Factor Loading Scores and Reliability Measures (Exp. 2)

Item	Factor Loading	Cronbach's Alpha
Purchase intention 1	0.932	0.881
Purchase intention 2	0.872	
Purchase intention 3	0.756	
Perceived quality 1	0.909	0.748
Perceived quality 2	0.577	
Perceived quality 3	0.723	

To test the hypothesis, we first compared the mean scores for purchase intention and perceived quality for the two countries. Table 5 shows the mean scores of the two dependent variables for the experimental conditions. The mean score for perceived quality was significantly higher for Canadian salmon (4.11) than for Chilean salmon (3.68; p=0.007), whereas the mean scores for purchase intention were not significantly different. We next tested whether the score differences between these two product origins were mitigated by store reputation. The MANOVA analysis showed no significant differences between the mean scores for purchase intention for the upscale store (3.61) and the discount store (3.84) or between the mean scores for perceived quality for the upscale store (3.90) and the discount store (3.87; table 6).

Table 5
Means (Standard Deviation) Across Experimental Conditions (Exp. 2)

	Upscale	Discount	Within-condition Mean
CoO with salmon disease (Chile)	PI: 3.47 (1.57) PQ: 3.72 (1.18)	PI: 3.63 (1.88) PQ: 3.64 (1.11)	PI: 3.55 (1.73) PQ: 3.68 (1.14)
CoO without salmon disease (Canada)	PI: 3.76 (1.76) PQ: 4.09 (1.18)	PI: 4.07 (1.69) PQ: 4.12 (1.20)	PI: 3.91 (1.72) PQ: 4.11 (1.18)
Within-condition mean	PI: 3.61 (1.66) PQ: 3.90 (1.19)	PI: 3.84 (1.80) PQ: 3.87 (1.17)	

PI: purchase intention; PQ: perceived quality.

Table 6
Hypotheses Test Results: Multivariate Analysis of Variance (Exp. 2)

		Purchase Intention F-values	Perceived Quality F-values
Main effect	CoO effect	2.429	7.407*
	Store effect	0.969	0.022
Interaction effect	CoO × Store reputation	0.112	0.142

Significance level: $^{*}p \leq 0.01$.

Discussion

The results show that Chilean salmon is valued significantly lower than Canadian salmon, which is consistent with the findings in Experiment 1. The mean perceived quality scores for Chilean salmon (from the discount store) are also similar between Experiments 1 and 2, indicating that the baseline case (salmon from a country with a disease outbreak imported by a discount retailer) for these two studies is comparable. In addition, the student sample from Experiment 1 did not yield responses that are obviously different from the more general population sampled in Experiment 2 in terms of mean responses. We did not, however, find any significant differences in scores between the two supermarket chains, indicating that no significant mitigating effects are gained by being associated with a retailer with a good reputation. In fact, the mean score for perceived quality for the upscale store is virtually the same as that from the discount store (3.90 vs. 3.87), and the mean score for purchase intention is lower for the upscale store than that of the discount store (3.61 vs. 3.84). This pattern is consistent across country of origin; the mean purchase intention score is lower for the upscale store than the discount store for both countries. In fact the perceived quality of Canadian salmon is lower for the upscale store than for the discount store.

These results are somewhat surprising because we expected that consumers would perceive higher quality from the upscale store. A possible reason for this result is that the upscale store is being punished for bringing in the disease-infected species, because consumers have higher expectations from a store with a better reputation, hence creating a relatively large gap in consumers' expectancy-value judgment for that store. In other words, the presence of the disease could be bringing down the store's reputation rather than the store's reputation bringing up the reputation of the disease-affected species. Another implication is that, although the disease itself is not considered harmful to human health, the news of the outbreak is highly influential in the formation of consumer perceptions, even to the degree that a guarantee from a reputable store cannot mitigate its effect. Moreover, this effect is persistent for both directly infected (Chile) and spillover countries (Canada).

Another potential reason is that Norwegian consumers may expect seafood products to be safe; that is, food safety is a minimal requirement that consumers expect any grocery store to fulfill regardless of its status (upscale or discount). Thus, the safety guarantee from the upscale store did not yield any extra value in consumers' perception as compared to the guarantee from a discount store. The implication from this result may be that the bundling of the upscale store image works well with attributes that are considered premium (*e.g.*, guaranteed freshness), but not as well with minimum requirements (*e.g.*, food safety).

Conclusion

The seafood market is becoming increasingly global (Anderson 2003). This creates a number of market opportunities that aquaculture, in particular, has been able to exploit. However, the global nature of the market also creates new challenges, as negative information also travels globally. This means that negative publicity can travel widely, and as the information is often complex, the impact can spill over to other products from the same source, as well as identical species from different regions and countries. This can be true for disease outbreaks as studied here, but also for other issues that are perceived to influence quality, such as labeling, product integrity, and consumer boycotts (Asche *et al*. 2010; Roheim 2009; Ropicki, Larkin, and Adams 2010).

The Chilean salmon industry's struggle continues because of the outbreak of the ISA disease and the resulting losses in salmon production. In this article, we conducted two consumer experiments to test several potential spillover effects. We find that consumers use disease outbreak information to infer the quality of other Chilean products and of salmon products from unaffected sources, and they perceive the seafood products from these sources to be of lesser quality. However, consumers seem to consider ISA-infected Chilean salmon as more representative of salmon in general than of Chilean fish, implying that fish farmers of the same species (in this case, salmon) in other countries may see larger negative spillover effects than Chilean producers of different species. Purchase intentions were less affected by the negative publicity for fisheries with unaffected species in Chile, perhaps because there are other mitigating factors unaccounted by the experiment (*e.g.*, relative prices). We also find that the effects from negative publicity cannot be mitigated by a positive spillover effect from a retailer with a good reputation. It seems that the negative effects are too influential and cannot be mitigated by store reputation; instead, an upscale retailer may be punished to a greater extent than a discount retailer for bringing in the affected species. Another potential factor is that product safety may be considered as a minimum requirement for any store, so the guarantee from an upscale store does not yield any extra assurance as compared to the same guarantee from a discount store.

This article contributes to the literature by showing that spillover effects exist and affect consumers' perceptions of quality and purchase intentions. However, further research is needed to better understand the complex mental mapping of consumers. For example, spillover effects seem to work differently depending on whether the effect is positive or negative and whether the attribute is considered as a minimum requirement or a premium. Consumer reaction may also be different in different countries. It is worth mentioning that the form of information used in our experiments, a mock newspaper article, is relatively indirect and subtle compared to methods used in many other marketing studies of seafood purchases that commonly use either conjoint choice experiment (*e.g.*, Jaffry *et al*. 2004) or contingent valuation methods (*e.g.*, Holland and Wessells 1998). The fact that we find significant spillover effects in Experiment 1 indicates that the negative information need not be direct and specific to influence consumer valuation. At the same time, the non-significant effect in the second experiment might be attributable to the indirect nature of the information; thus, further research may be warranted to investigate the effect of the information format and content.

The management of disease is a regular part of any animal production practice. However, events resulting in negative publicity may influence consumer valuation of not only the areas or species that are directly affected by the event, but also of other areas and species that are not directly affected. Although we studied the case of an outbreak of disease in salmon in Chile, our results may apply to any event that results in negative publicity; for example, negative environmental consequences of fish farming. Thus, collective actions to prevent such negative publicity, as already put forth by the aquaculture industry in some cases, may benefit the industry as a whole.

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