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A Case Study of Heptachlor Contamination of Oahu Milk

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CONSUMER RESPONSE TO FOOD CONTAMINATION: A CASE STUDY OF HEPTACHLOR CONTAMINATION OF OAHU MILK

By

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ABSTRACT

CONSUMER RESPONSE TO FOOD CONTAMINATION:
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OF OAHU MILK

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The 1982 pesticide contamination of Oahu, Hawaii, milk with heptachlor provided a rare opportunity to study consumer response to food contamination. A major objective was to develop methodology to estimate producer cost from lost sales due to consumer awareness of contamination. Other objectives were to estimate sales loss to Oahu dairymen, examine such incidents' characteristics, and draw policy implications.

An econometric model considering consumer awareness of contamination, contamination's extent, and possible consumption habit changes was less restricted and provided better loss estimates than previous models.

Policy implications include protection of long-term industry interests through protection of short-term consumer interests by recalling all contaminated product. Following contamination, even favorable news may not increase sales; attempts to counter bad publicity are not recommended. Significant producer incentive exists

to avoid lost sales, but unless benefits or costs of individuals' actions are fully captured, market forces alone will not guarantee food safety.

To my parents, Eugene J. and Marie B., and my brothers, Paul A. and Tony B., without whose help and support this would not have been possible. Also to A.M.D.G.

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

In March 1982, most milk on the island of Oahu, Hawaii, was discovered to be contaminated with the pesticide heptachlor, a suspected carcinogen. Since the milk market there is physically, and by state law, legally, separated from any other major market, the situation provides a natural laboratory for the economist to study the response of consumers who were aware of contaminants in their milk supply. One of the purposes of this study is to develop a methodology to determine the loss to producers from lost sales due to consumer awareness of food contamination. The methodology developed here is applied in a case study of the Oahu incident. Characteristics of the incident and government and industry response are examined to draw public policy recommendations.

This research merits attention by several groups. Knowing the magnitude of this cost would assist government regulators who weigh the balance between increased monitoring or imposed fines to enforce food safety regulations. As government regulation comes under increasing scrutiny, the question of government product inspection versus private inspection by producers, especially of livestock and livestock products, is raised. Is the threat of lost sales because of consumer

awareness of contamination enough incentive to prevent the producer from violating food safety regulations? Knowing the characteristics of massive food contamination incidents would also help government officials devise strategies to handle them, to protect public health and the industry involved.

Producers who are victims of such an incident will benefit from this study. They often often cite a decline in sales, which is attributed to consumer fears of the contamination. However, in lawsuits and testimony before government bodies, this additional cost has not been quantified and so has not been recoverable from those responsible for the contamination. Losses from product and feed dumped, laboratory, veterinarian, and legal fees, and losses from death of livestock are more easily quantified.

The effects of a food contamination incident are not limited to producers of the contaminated product. Producers of the same, though uncontaminated, product may suffer sales loss. Producers of substitutes may benefit as consumers alter consumption temporarily or longer-term consumption habits. Producers of vegetarian foods may benefit from concern over additives and contamination of meat products. Conversely, producers of complements of a contaminated product may suffer reduced sales after a contamination announcement. Knowing the economic consequences of contamination will help such producers.

Further, consumers will find this study of interest by understanding the characteristics of such incidents. They may then know what to expect in the aftermath of such occurrences. Understanding the

environment in which government officials responsible for public health operate, consumers may exert influence to achieve the desired government response.

1.1 Background

Consumer protection from adulterated food has been a federal concern since the beginning of this century when the Pure Food Act (1906) and Federal Meat Inspection Act (1907) were passed. As food-production processes became more complex, so did federal regulation (see Kessler, 1984). Maintenance of food safety involves protection from mislabelling, poor packaging, additives (e.g., preservatives, dyes), residues (e.g., animal antibiotics), and environmental contaminants, such as heavy metals, aflatoxin, pesticides, and other organic compounds that are unintentionally present in the environment of people or animals.

Most of the more prominent contamination occurrences involve this latter group of substances. The earliest in recent history was the "Great Cranberry Scare of 1959," when shortly before Thanksgiving the Department of Health, Education, and Welfare announced that cranberries may have contained residues of amino triazole, a herbicide and potential carcinogen. As a result, producers claimed sales were depressed at a time of normally peak demand. In 1968, about 20 percent of Montana's milk supply was contaminated with the pesticide heptachlor after chlordane, a related chemical, was sprayed on alfalfa fed to dairy cows. One dairyman noted:

> The great furor of publicity that this [contamination] aroused

> caused the public to be afraid to drink milk and caused a very noticeable drop in our sales. It was months before the milk outlets returned to normal, and in many cases, it still is not. (Boylan, 1969)

The largest U.S. food contamination incident occurred in 1973, when polybrominated biphenyl (PBB), a fire retardant, was accidentally mixed with feed in Michigan. Initially believed to be an isolated occurrence, the statewide scope of the problem was slowly realized by government officials. It is believed that about 90 percent of Michigan residents at the time were exposed to PBB in their beef, pork, lamb, eggs, and milk (Chen, 1979). The state spent about $250,000 in a campaign to restore consumer confidence in Michigan agricultural products after Canada temporarily closed its border to Michigan meat products and consumers sought out-of-state foods. The Congressional Office of Technology Assessment (1979) estimated the cost of condemned food at $215 million. Eleven years after the occurrence, lawsuits are still being resolved, and at least one dairyman believes milk sales are still slightly depressed.

Since 1973, a succession of contamination incidents has captured public attention. In 1979, a damaged electrical transformer in a Montana meat-packing plant leaked polychlorinated biphenyl (PCB), which contaminated animal feed and food for human consumption. The incident affected 18 states and two foreign countries at a cost of $11 million to producers and state and federal agencies (USDA, FSQS, 1980b). Again, concern was voiced about a slump in sales of livestock products (see Rede, 1979). In 1982, heptachlor contamination of Oahu milk was discovered, leading to numerous recalls of milk and dairy products and

consumer doubts of island milk quality. After reports of dioxin contamination of some Great Lakes fish, sales to New York City, a major market, dropped by about 80 percent, even of those species that were uncontaminated (Peterson, 1983).

Most recently, concern over the fumigant ethylene dibromide (EDB, not technically an environmental contaminant) caused confusion in supermarkets. State and federal agencies scrambled to define safe levels of the compound amid rumors that large amounts of grain would have to be dumped. Sales of cake mixes, after their EDB concentrations were publicized, were particularly affected. "Cake-mix sales have dropped to zilch--people aren't even going near that aisle" (Beck & Hager, 1984).

The environmental contamination problem of livestock is one of relatively few large-scale incidents and many other small-scale incidents for which there is little aggregated data. Van Ravenswaay and Smith (forthcoming) estimated that nationally from 1974 through 1978, about 1,000 cattle and 200 hog operations were annually affected by environmental contamination. Aggregate direct costs borne by such producers were very small compared to the worth of the industry as a whole, but individuals may have borne significant costs, and it is unknown how minor incidents affected sales of meat products. Some fear a shift away from meat consumption and a rise in more vegetarian habits. Such incidents are often handled quietly to minimize consumer concern over food safety.

The Office of Technology Assessment (1979) surveyed 50 states to determine the cost of environmental contamination in food but did not estimate reduced sales stemming from the incidents. Of 32 responses, only 18 reported at least one incident between 1968 and 1978. Only six estimated the cost of food condemned for a total of $67 million, excluding Michigan's PBB incident. Since many states were unable to provide estimates, the authors concluded this figure may be grossly underestimated.

Another question associated especially with the larger incidents is that once they occur, government action may protract consumer awareness of the problem and may worsen consumer attitudes toward a contaminated product. Investigations (Hawaii Senate, 1983; USDA, FSQS, 1980a) may reveal poor government performance in protecting public health, and accusation of a cover-up raises questions of government's intent and desire to safeguard the consumer.

1.2 Research Approach and Organization of Thesis

To estimate producer sales losses due to consumer awareness of contamination, an estimate of what sales would have been in the absence of the incident is compared with sales in light of the incident. Hence an econometric model of Oahu fluid milk demand is estimated. An analysis of government and industry response to the incident, based on a review of more than 500 newspaper articles, government reports, and numerous conversations with related industry and government officials in Hawaii, California, and Washington, D.C., is included to supplement the study of consumer response.

The next two chapters familiarize the reader with the Oahu milk market and the impact on it of heptachlor contamination. Chapter Two presents a study of the Oahu market, the first of its kind in almost 25 years. Chapter Three presents a chronology of the incident which details consumer confusion and resistance to purchasing milk and milk products after the contamination announcements. It also describes actions by State officials and the Hawaiian and Californian milk industries in response to the incident. Chapter Four develops the theory and methodology of the study. A review of the literature of consumer response to negative product information and to recalls and health scares in particular is presented. The appropriate econometric model is then developed. Chapter Five presents the findings of the model, a study of media coverage of the incident, and demographic analysis of consumer response to the incident. The last chapter summarizes the study and discusses the economic consequences of food contamination, including characteristics of massive food contamination such as the Oahu heptachlor and Michigan PBB incidents. Public policy implications are drawn with regard to minimization of public health threats and industry losses after a food product has been contaminated and to the roles of government and industry in enforcing food safety regulations.

CHAPTER TWO

THE OAHU MILK MARKET

To build an econometric model of demand, an understanding of the market under study is fundamental. This chapter builds upon studies conducted in Hawaii in the 1950s through the early 1970s, more recent reports including those by the U.S. Justice Department, and personal conversations with industry and government officials on Oahu.

2.1 Production

Milk is the only major food in which Hawaii is self-sufficient. Of the 25 herds in the State with ten or more cows, 16 operate on Oahu to produce about 80 percent of the State's supply. A similar percentage of the State's population resides on the island. In 1980, Hawaii had the nation's largest average herd size of 520 cows per dairy with mostly Holsteins in drylot operations (Koshi, 1980). Since at least 1968, all production has been of Grade A quality. Average 1981 production per Hawaiian cow was 11,811 pounds, below the national average of 12,147 pounds, but slightly higher than that of Florida and most other southern and south-eastern states. In 1981, Oahu held 9,600 of the State's 12,700 cows. Monthly Oahu production averaged about 9,893,140 pounds over the 1977-1981 period. Average

1982 output fell 8 percent to about 9,116,060 pounds and was the lowest in six years (Hawaii ARS, 1983). Production varies monthly, usually peaking in late spring and bottoming out in the fall. Since at least the early 1960s, production has been kept 10 percent above "normal demand" to handle fluctuations (Mollett, 1961).

The cost of milk production in Hawaii is the highest in the country (Cohen & Eisenstat, 1983). Chief problems as seen by the industry relate to high feed costs and low reproductive rates (Morrison, Kefford, & Harada, 1981). Without pastures on Oahu, all feed must be purchased and much must be imported. Reliable feed supplies are sometimes precarious since only one firm transports feed from California and feed storage facilities are lacking. Imports of prepared animal feed, mostly from the mainland, averaged 108,000 tons per year from 1977 through 1981. Because of the heptachlor contamination incident, green chop (ground pineapple plants used for forage) is no longer used requiring more imports.

Further adding to high costs is unionized dairy farm labor earning an average of $7.30 per hour (Hawaii DPED, 1983). Wasteful labor use was found on Oahu dairies in Mollett's 1961 study, but it is unknown to what extent this has continued. Dairy replacement costs also boost production costs. Replacement calves are shipped to the Outer Islands to be raised, and then returned to Oahu.

Despite the problems they face, Oahu dairymen earn a relatively favorable return on investment. The 1979 average return for 12 dairy operations was 10.77 percent (Donoho, 1980). The 1979 prime interest

rate was 10.91 percent. Conscious of possible mainland competition, the industry has pressed the State and University of Hawaii to investigate means to reduce costs. At least one dairy cooperative was trying to use a local grass hay by 1980 (Koshi, 1980).

2.2 Processing

At the processor level, a duopoly exists on Oahu and apparently has since at least 1958. The larger of the two, Meadow Gold Dairies-Hawaii, is a subsidiary of Beatrice Foods and has operations on other islands. It received 59.5 percent of milk produced on Oahu prior to the contamination announcement (Hawaii Senate, 1983). Foremost Dairies, Hawaii, a subsidiary of Foremost-McKesson, handled 40.5 percent of the pre-recall production (Hawaii Senate, 1983). In addition to island milk supplies, Meadow Gold imports dry milk fat from the mainland while Foremost imports it from New Zealand (Harpham, 4/20/83). Processors supply: homogenized, 2 percent, 1 percent, skim and flavored milk, buttermilk, half-and-half, ice cream, ice milk, ice milk mixes, yogurt, cottage cheese, and sour cream. Both are heavily involved in fruit juice processing also. Local production accounts for all fresh fluid, and 75 percent of ice cream consumption (Morrison, Kefford, & Harada, 1981).

As are costs of milk production, processing costs are higher than those on the mainland. (Information for this discussion is mostly from Harpham, 5/12/83.) Labor, utilities, transportation, and packaging costs are greater. Likewise, since the price processors pay for raw milk is higher, the 1.5 percent shrinkage (the same experienced

on the mainland) costs more. In a pocket economy, processors cannot achieve the economies of scale possible on the mainland. One Honolulu plant with 60 employees processes 17,000-20,000 gallons daily, while a mainland plant could employ 70 and process seven to nine times as much. The same Honolulu plant could increase production four times to reduce per gallon costs, but demand does not warrant increased production.

In early 1983, Oahu dairies and processors employed 574 people (360 in processing/distribution and 214 on farms); total State dairy industry employment was 720 workers. Directly and indirectly the industry supported about 1,900 jobs or a little more than 0.4 percent of total Hawaiian employment in 1981 (Hawaii DPED, 1983).

2.3 Government Regulation

Beyond government involvement to ensure a safe milk supply, the State regulates production, transportation, processing, storage, distribution, and delivery of milk under the Milk Control Act. The Division of Milk Control establishes quotas and minimum producer prices. Similar to mainland markets, producers are paid a blend price based on utilization. The 1967 Act was passed in an atmosphere of violence and milk dumping. Producers felt they were not receiving a fair price from the two processors who had not increased producer price for 15 years (Lynch, 9/29/83). The two milk sheds of Honolulu and Hawaii were created. (Operations are fully integrated on Maui and Kauai; five producers sell to two processors on Hawaii.) Only with a license granted by the Board of Agriculture may a firm import fluid

milk. Military commissaries are not subject to the Act though and may import whatever they wish.

2.4 Coordination

The Division of Milk Control and two Oahu dairy cooperatives help achieve horizontal coordination among producers. Raw milk supply is regulated by quotas the Division establishes for each producer. Five producers who account for about 40 percent of the island's quota form the Oahu Dairy Cooperative. Eight others, producing 27 percent, are members of the 50th State Dairy Farmers' Cooperative.

Mechanisms to improve vertical coordination are known to exist at two levels. At the farm input level, most Oahu dairymen joined the Green Feed Cooperative to harvest and distribute green chop. Green chop is available from the two major pineapple companies which would normally burn and clear the fields in preparation for the following year's crop.

At the producer-processor level, the State market order helps ensure dairymen a market, even though neither producer cooperative has any processing capacity. Both cooperatives and the University of Hawaii's herd supply both processors. Both processors themselves are fully integrated. Based upon quota allocations, Meadow Gold's farm is the second largest on Oahu, and accounts for 17 percent of island production. Foremost Farms ranks third with 15 percent.

2.5 Marketing

The sizes of milk marketing channels are unknown, even to State officials (Cohen, 1983). A beef marketing report (Garrod & Ching, 1982) is the most recent study showing marketing channels for any Hawaiian agricultural commodity. In 1980, almost half the market supplies were distributed through retail grocers, a third through restaurants and hotels, a tenth through the military, and the rest through institutions and direct marketing. While beef marketing channels differ from those of milk, this gives some idea of the relative magnitude of sales through each type of distribution. It is known that military-related sales have accounted for 12 to 15 percent of fluid milk consumption, and tourist-related sales have been about 10 to 12 percent over the last five years.[1] During the school year, about 20 percent of fluid consumption is purchased by the Department of Education (calculated from Harpham, 9/25/82).

With a duopoly among processors, competitive behavior would not be expected. Though perhaps tacit, collusive pricing would be expected in recognition of their mutual interests. Likewise, advertising and product strategy would be undertaken with consideration of possible countermeasures by the other. From The Honolulu Advertiser's weekly "Retail Food Price Guide" from January 1977 through December 1982, there is no evidence of a fluid milk price war between the two. Monthly average whole milk prices in the first half of 1983 were

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[1]Results of a survey conducted by the author of individuals knowledgeable of the Oahu dairy industry, 1983.

generally lower than 1982 levels though. No generic advertising is undertaken; milk is differentiated by brand advertising. The milk companies are not considered major advertisers by some in the advertising trade. Historically, advertising by one increased with the introduction of a new product (dairy-related or not). Before the spring of 1983, the last such event occurred a little more than five years ago. Based upon television advertising expenditure data from two of Oahu's four commercial stations, Meadow Gold spent almost twice as much as Foremost in 1981 and 1982, and more than seven times as much in the first half of 1983. Also, following the heptachlor incident, Meadow Gold changed its package design. While this change was part of a national marketing strategy it did help Meadow Gold break with a bad product image. In May 1983, Foremost packaged "Dairyland," a new private label milk for Foodland Super Markets, the largest grocery chain in the state. That month, "Dairyland" sold for $1.59 per half-gallon, or 5 percent less than the Foremost-Meadow Gold price of $1.67 (Harpham, 5/12/83). It thus appears some competitive behavior does exist between processors.

An interesting aspect of milk marketing on Oahu is that the processor truck drivers play a key role balancing quantities supplied with quantities demanded. They remove expired milk or milk nearing its expiration date and leave enough fresh milk to meet what they believe the store will need. No grocery store executive has easily available data on the amount of milk returned from his/her store.

Shipment of milk between islands is infrequent since each island is basically self-sufficient. The last milk shipment from Oahu to Hawaii was in 1980. Milk was shipped from other islands to Oahu after the contamination announcement in March, April, May, June, October, and December 1982. Approval for such shipments is granted by the State's Milk Commission.

2.6 Consumption

Per capita Oahu milk consumption has been declining. In 1962, per capita annual fluid consumption averaged about 214 pounds, but fell to 160 pounds by 1971 (Hogg, 1974). By 1981, consumption was about 153 pounds per year per person or about 80 percent of that on the mainland (Morrison, Kefford, & Harada, 1981). Ethnic origin influences consumption; the Caucasian population consumes more than other racial groups (Consumer Nutrition Center, 1981). In 1962, Scott (1967) found that Caucasian adults and children drank milk more because they liked it than for its nutritional value, while other groups (mainly Japanese, Chinese, Hawaiian, and Filipino) consumed it more for its nutritive value than taste. Caucasians account for 33 percent of the Oahu population, followed by Japanese (25 percent), Filipino (13 percent), and Hawaiian (11 percent) (U.S. Census, 1982).

Raw milk is utilized in several ways (Table 2.1). It is assumed that Class I utilization approximates the quantity demanded of fluid milk at least over the pre-contamination period. Seasonality is evident in its demand (Figure 2.1). Fluid consumption falls with the summer recess of school and rises with September school openings. In

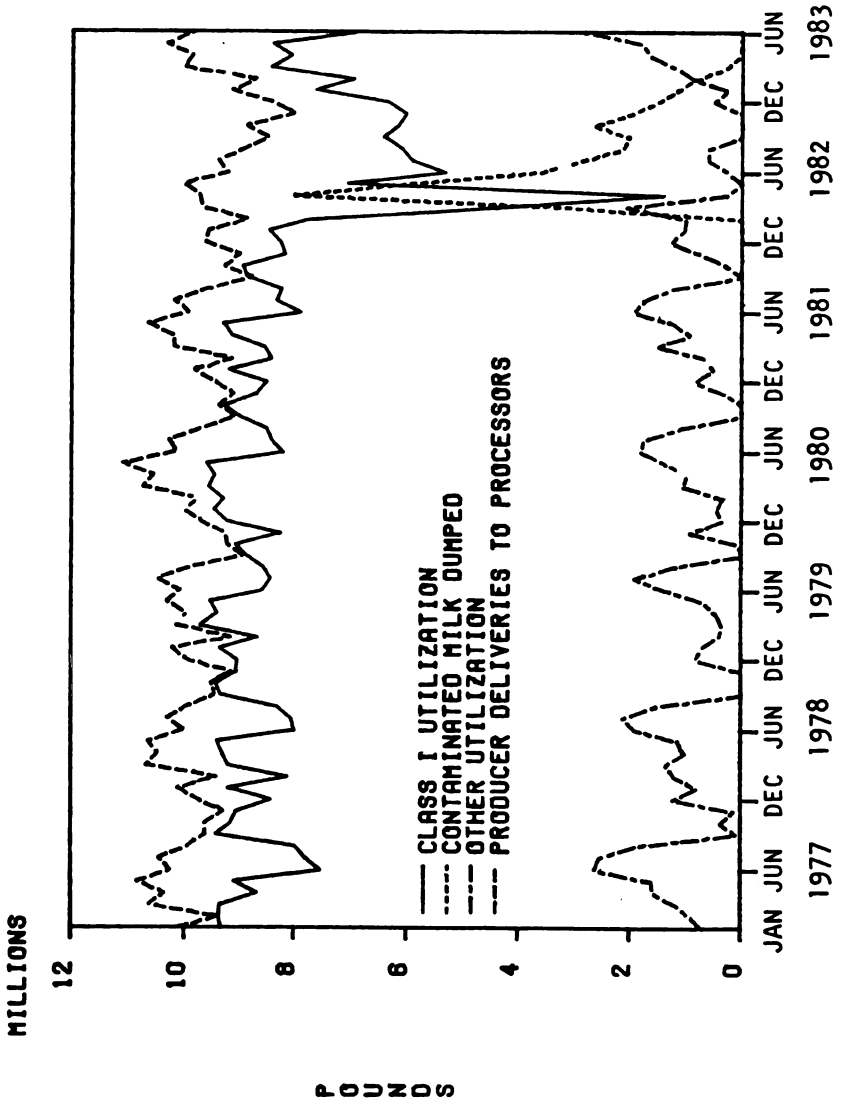


Figure 2.1.--Oahu milk production and utilization, January 1977-June 1983.

the past, troop movements in and out of the state significantly affected consumption, but it is unknown how important a factor this is now. In general, Class I-A and Class II utilization rises in the summer, only to decline (often to zero) when schools open. However, summer Class I-A and Class II utilization does not always rise enough to counter the fall in fluid consumption. "Traditionally, the Honolulu Milk Shed experiences its greatest loss through dumpage during the summer months" (cited in Cohen & Eisenstat, 1983).

Table 2.1.--Forms of Oahu milk utilization.

Utilization	Description
Class I	Used for fresh fluid consumption (e.g., whole, 2%, and other fluid milk).
Class I-A	Skim milk available for use in filled (imitation) milk.
Class II	Soft manufactured dairy products (e.g., ice cream, yogurt).
Export	Fresh fluid milk exported to Neighbor Islands or for use on airlines and ships.
Salvaged	Raw milk from which the cream is skimmed and used in some Class II products. The skim milk is then discarded.
Dumped	Raw milk disposed of due to excessive heptachlor residues.

There are several fresh milk substitutes available on Oahu. The milk processors produce filled, or imitation milk, and recombined

milk. The same year the Milk Control Act was passed, processors introduced filled, or imitation milk. This is made "by adding vegetable oil in place of butterfat to either fresh skim milk or reconstituted skim milk" (Hawaii Senate, 1983). Its market share had fallen from 20 percent in 1967 to 7 percent in 1981 (Renaud, 1971; Morison, Kefford, & Harada, 1981). Filled milk prices are less than that of fresh milk. In July 1983 (latest month for which data are available), the filled milk price was $1.39 per half gallon compared to $1.68 for whole milk. Recombined milk "is a product which results from the combination of nonfat dry milk, dry cream, [and] milkfat with potable water" (cited in Hawaii Senate, 1983). Ultra-high temperature (UHT) milk was allowed to enter the Hawaiian milk market with licenses granted in fall 1983 to Dairymen, Incorporated, and Real Fresh, Incorporated, a California firm. Other milk substitutes include powdered and nonfat dry milk, neither of which is produced locally. Dried milk and cream imports from 1977 through 1981 averaged 647 tons per year, ranging from 611 tons in 1981 to 750 tons in 1977 (U.S. Army Corps of Engineers, 1977-1981).

2.7 Summary

The Oahu milk market is high-cost, imperfectly competitive, and confronts the seasonal demand of consumers, many of whom do not drink milk for taste alone. Government regulation limits the entry of new dairymen as does the duopoly at the processing level. Further, fresh fluid milk supplies from sources beyond the State were, until very

recently, limited by logistical problems of shipping a perishable product over great distances (2,500 miles from California) and by the State's Milk Control Act. However, such protection may have been necessary to preserve the islands' milk self-sufficiency, and even before the contamination incident, Oahu dairymen were concerned about possible competition from outside sources. Per capita milk consumption is below the U.S. average, reflecting the racial differences in tastes for milk. The insular nature of the Oahu milk market makes it a prime market to study consumer response to food contamination.

CHAPTER THREE

THE OAHU MILK CONTAMINATION INCIDENT

The following details most events surrounding the heptachlor contamination of Oahu milk and its consequences. It focuses on the origin of the contamination, and consumer, government, and industry reaction from the initial discovery in January 1982 through June 1983. Specific information on the culpability of individuals involved is available in the Report of the Senate Special Committee Investigating Heptachlor Contamination of Milk (1983). This chronology is compiled from that report, over 500 newspaper articles and letters to the editor in the two major Oahu newspapers, the Honolulu Advertiser and Honolulu Star-Bulletin, numerous other articles, and conversations with many individuals in Hawaii and elsewhere.

3.1 Chronology

3.1.1 The Contamination

The story of milk contamination began in Oahu's pineapple fields. Pineapples suffer from mealybug wilt, named after the vectors which feed on the crop. Ants protect the insects from predators because ants consume the mealybugs' "honeydew" secretion. It was found that by eliminating ants, mealybug wilt could be controlled. To

do this, DDT was first used, followed by mirex, followed by heptachlor, all organochlorines, and hence extremely persistent in the environment.

In the 1960s the U.S. Food and Drug Administration (FDA) set a zero tolerance for heptachlor in food. An action level (the level of residue which will prompt FDA action on a product lot) of 0.3 parts per million (ppm) on a fat basis was established since no smaller quantities could then be detected. In laboratory animal tests, heptachlor has caused liver and kidney damage and is a suspected human carcinogen. It is estimated that about 90 percent of Americans carry heptachlor residues in their bodies. The EPA banned heptachlor use in 1978, but granted an exemption to the Hawaiian pineapple industry. A stipulation was that growers had to wait one year after the last application before a field could be harvested for animal feed.

Pineapple plants had been harvested as "green chop," a cheap, local substitute for imported dairy forage since 1958. With help from the Department of Agricultural Engineering at the University of Hawaii (UH), harvesting became more efficient in the late 1970s and included the base of the plant, where heptachlor apparently accumulated. It was later found that green chop samples from April 1981 contained high heptachlor levels. Being fed to dairy cows, the pesticide was excreted in the milk. It is now believed the Oahu milk supply contained heptachlor as early as October 1980. Violative levels were present in milk bottled in April and May 1981, and high but nonviolative levels were found in ice cream made that May. However, milk bottled in July and August was found to be below the action level. The State Department of

Health (DOH) semi-annually checked for pesticide contamination in milk, and no violative levels of heptachlor were detected in the July 1981 tests.

On January 22, 1982, DOH Food and Drug Branch Chief Karl Tomomitsu received test results from a sample of homogenized milk and samples of raw milk from three dairy farms, all violating the action level. These samples were taken January 6. Other samples taken January 13 showed no detectable heptachlor residues. Upon recommendation from the lab, Tomomitsu sent the older samples to the FDA lab in California. Three days later, the lab sent the samples with no note of urgency attached. Tomomitsu did not develop an action plan in case the original results were confirmed, and did not inform his superiors. By January 22, all milk produced January 6 and used for fluid consumption had either been sold or had expired, but Class II products could have still been for sale.

Thirty-five days later on March 1, confirmation by the FDA was received. Tomomitsu initiated an investigation to detect the source and extent of the contamination, assisted by Milk Commissioner Roy Matsuura. Neither informed their superiors. Eight farms, including the three previously tested, and both processors were sampled March 9. Two days later, Tomomitsu informed his superiors of the contamination, including DOH Deputy Director for Environmental Health Melvin Koizumi. Dean Noel Kefford of the UH College of Tropical Agriculture was consulted after the UH lab confirmed the contamination. Kefford wrote Commissioner Matsuura:

> . . . Continued consumption of milk with the reported heptachlor epoxide residues would not appear to constitute an unreasonable hazard to the general public, even those judged to be most sensitive. More serious would be an announcement of this technical violation of a tolerance . . . and subsequent prohibition of the sale of milk from dairies and processors. No amount of explanation of the technical nature of the violation would expiate the damage done to the reputation of milk as a wholesome food and coincidentally to the dairy industry . . . [p]recipitate action which results in a perception by the public that the milk supply contains hazardous materials should be avoided. (Hawaii Senate, 1983)

On March 15, test results indicated both processors and seven out of the eight farms sampled were in violation of the action level. The next day, Deputy Director Koizumi informed DOH Director George Yuen, an engineer, who ordered more tests to determine whether contamination levels were falling. A day later, the same eight farms were retested. By Thursday, March 18, the media learned of the contamination and a report appeared about possible State action in the afternoon paper. At 4:30 p.m., before the latest sampling results were known, the DOH ordered the first of eight mandatory recalls.

3.1.2 The Recalls and Their Aftermath

Oahu residents read across their next morning's newspaper, "Toss out that milk in fridge--it contains pesticide poison." Pulled from shelves were homogenized, 2 percent, 1 percent acidophilus (for those allergic to milk), and half-and-half milk. Since heptachlor concentrates in the butterfat, skim milk was not pulled and neither were those products processors said were made with imported butterfat (ice cream and other Class II products). Imitation milk was declared safe. Foremost did not announce that it also pulled buttermilk and sour cream it believed might have been contaminated. Health Director

Yuen believed this was an isolated incident and said the public was not endangered even though heptachlor levels three to six times the action level were found. Supplies on grocer shelves that day were deemed safe. When asked about the delay in pulling milk, Yuen answered, "It took time to determine the exact course of action to take" (in Hastings & Harpham, 3/19/82). The Department of Education switched from serving fresh to imitation milk in schools.

Both processors offered consumer refunds as about 180,000 gallons of milk were dumped. Meadow Gold President Robert Milne encouraged the public to call his company with any questions. Dr. James Koshi, former dairy specialist with the UH and general manager of the 50th State Dairy Farmers' Cooperative, assured the public, "We're out to produce the best product" (in Hastings & Harpham, 3/19/82).

Within 36 hours of the recall announcement, acceptable milk supply was only more than half of normal supply. Both Meadow Gold and Foremost cut half-and-half production, with Meadow Gold supplying normal levels of whole and 2 percent milk. Meadow Gold's estimated loss from dumped milk and milk refunds was $250,000 (Harpham, 3/20/82). Foremost, whose supply was more drastically affected, increased production of imitation milk. Governor George Ariyoshi and health officials assured that the public was not endangered, and most, but not all, medical experts who were quoted agreed. Lack of consensus of heptachlor's health effects was constant throughout the incident. Criticism

of the DOH's delay began to be voiced, as well as dairymen's anger that they had not been informed of the problem.

Supermarkets reported heavy returns and initially brisk sales of powdered and canned milk before consumers learned that imitation and skim milk, in plentiful supply, were safe. Neighbor Island milk sales were down, even though contamination was limited to Oahu. Calls to hospital emergency rooms increased. Meadow Gold was flooded by telephone inquiries but continued to invite such calls, saying "We feel people have the right to know" (in Harpham, 3/20/82).

Meadow Gold dumped so much milk down the storm drain and not into the sewer system as directed by the DOH that the channel into which it emptied became de-oxygenated. Tens of thousands of fish died and attracted newspaper photographers. Dairy cow slaughter was halted until pesticide tests were performed, which later showed heptachlor levels above the action level.

Headlines on Tuesday, March 23, reported that two of the three acceptable dairies supplying Oahu were actually in violation of the action level. Hence, it was possible unacceptable milk had been consumed over the weekend. It was later learned that Meadow Gold knew some of its supplies were probably contaminated. Foremost's only fresh milk supply was imported from Hawaii and Maui. No milk was recalled, but one supermarket voluntarily pulled milk from its shelves. Some stores had posted signs saying the milk was safe, and several store managers were now confused about milk safety. The DOH allowed the processors to use contaminated milk to make skim milk, and most milk

available was skim, imitation, and recombined. Consumer refunds continued. Senate Health Committee Chairman Benjamin Cayetano heightened criticism of Health Director Yuen, just stopping short of calling for his resignation.

Less than a week after the first recall, the DOH ordered Meadow Gold 2 percent milk pulled as a precaution for violative heptachlor levels. Meadow Gold offered a refund. Some stores reported milk stock-outs by closing time, but many others reported no milk, even skim and imitation, was selling. Sales of condensed milk were up, and runs on powdered milk were reported. Comments by store managers reflected the situation: "Consumers are confused--they just don't know what's safe now" (in Harpham & Hastings, 3/24/82). "People . . . have kind of lost confidence and think no one really knows what's happening. So they're staying away until things are sorted out. . . . Recent events have set back the dairy industry 10 years" (in Kakesako, Gomes, & Morita, 3/25/82). "The state really blew it" (in Watanabe & Morita, 3/24/82).

Two small dairies were cleared, but 95 percent of Oahu cows were contaminated. Chairman of the UH Department of Animal Science Richard Stanley stated that one bad batch of green chop fed for two to three weeks in December was responsible for the incident. It was a "one-shot incident" (in Harpham & Hastings, 3/24/82). Meadow Gold joined Foremost by importing milk from other islands; total March imports were 8,250 gallons. The DOH announced that test results were needed before a recall could be ordered, a policy not followed for the

first recall though. The health director said the DOH lacked adequate lab facilities, but that it was trying to increase the frequency of testing and improve internal communications.

A week after the first recall, Gov. Ariyoshi, Health Director Yuen, and UH officials again tried to reassure the public that milk was safe, the recalls were precautionary, and that there was "no evil force at work" (in Kakesako, Gomes, & Morita, 3/25/82). Dean Kefford explained that the action level is a regulatory level and does not necessarily indicate a health threat if violated. But Sen. Cayetano began publicly questioning the use of raw contaminated milk to make skim milk and asked the Attorney General to investigate its legality.

Ten days after the first recall, Foremost milk distributed in Waikiki was pulled for heptachlor levels above the action level. The milk came from a dairy previously cleared by the DOH, and Foremost President Paul Heckenlively declared, "If they [the DOH] don't get their act together, the milk industry will be destroyed" (in Ong, 3/28/82). Dairymen also blamed the confusing DOH test results for causing confusion in the marketplace. The State agency announced it would try a new sampling procedure "because some of what [the DOH has] gotten up to now has not been representative" (in Harpham, 3/30/82).

March went out like a lion. The fourth recall in less than two weeks was announced, together with Health Director Yuen's immediate effective resignation and the appointment of his successor. The DOH pulled Meadow Gold cultured buttermilk, and the Attorney General began investigating whether the company knowingly used milk of an unknown,

and so possibly contaminated, origin. Again, Gov. Ariyoshi declared the safety of milk, but processors had more milk than could be sold. Supplies were low, but demand was apparently less. Ample supplies of imitation and recombined milk were available. Yuen cited personal reasons, and not the milk crisis, for leaving. He partly blamed the dairy industry for the crisis and accused the media of accentuating the negative. Sen. Cayetano, unsure if milk on the shelves was safe, claimed Yuen's resignation was the first step toward restoring public confidence. That confidence had been shattered, and former Superintendent of Education Charles Clark, with no public health background but a reputation as an efficient administrator, was chosen by the Governor to succeed Yuen.

April began with much media attention given to the poor State handling of the situation. Sen. Cayetano criticized the Governor for failing to take action and blasted the DOH for slow action, which he claimed eroded public confidence in government. He accused the DOH and dairy industry of putting economic considerations before protection of public health. The Senator was also appointed Chairman of the Senate Special Committee to investigate the incident. Charles Clark was endorsed by the Honolulu Advertiser, which editorialized, "Many people will be understandably skeptical about the milk situation for a while . . . despite assurances from some in government, including Yuen and medical people that milk was safe to drink all along" (4/1/82). Also in early April, health department tests cleared yogurt, cottage cheese, and Meadow Gold ice cream, even though the ice cream was unexpectedly

found to have heptachlor at the action level. The DOH had previously believed only mainland butterfat was used in its production, so no heptachlor should have been present. No recall was ordered since the action level had not been violated.

Milk sales remained sluggish. Chairman Jack Suwa of the Board of Agriculture said, "[Milk] is on the shelf and it is up to the milk industry to convince [people] it is safe. . . . This whole thing (the milk crisis) wasn't handled according to the consumer angle and that is why we have this fuss" (in Harpham & Burris, 4/2/82). Safeway offered to import milk, but did not press the matter given ample milk supplies.

On April 5, recalls extended beyond fluid products to other dairy products. Meadow Gold voluntarily recalled some of its ice cream for suspected contamination. Meanwhile, the UH Pesticide Hazard Assessment Project tested mothers' milk from six women and found all six with heptachlor levels four to ten times those found two years earlier. One sample was above the action level.

The next day, Acting Health Director Clark introduced an improved sampling procedure by saying, "We think we have made our last recall" (in Harpham, 4/6/82). With the cooperation of the agriculture department, both processors, and the UH, milk would be tested three times: upon delivery to processors, in their holding tanks, and in finished products. FDA experts were requested to help improve DOH testing. Meadow Gold and Foremost would hold products until cleared. Clark praised both processors for their cooperation, and the Attorney General cleared Meadow Gold of intentionally using possibly

contaminated milk. Human error on an employee's part was blamed. Skimming contaminated raw milk was still of questionable legality, but it seemed the situation was finally getting under control.

Clark's blitz to restore public confidence was undercut the next day, when Meadow Gold voluntarily pulled yogurt. (Yogurt had previously been cleared.) Worse, the yogurt sample in which excess heptachlor was detected was not an "official" sample but part of a DOH employee's lunch who asked that it be tested "for the hell of it" (in Harpham & Hastings, 4/8/82). Clark admitted that the DOH had to trust processors to ensure all contaminated products were pulled.

> Low sales figures, ample supplies of state-cleared milk at the processing plants and in the stores and rising sales of competing products such as milk powders or imitation milk already make it abundantly clear that Oahu consumers don't believe state assurances that all whole milk released to market is wholesome and safe and cleared of heptachlor. (Lynch, 4/8/82)

Sen. Cayetano criticized the DOH for considering the economic future of the dairy industry instead of public health. Meadow Gold was blamed for the last recalls because its officials told DOH that only mainland cream was used in the recalled products when actually some Oahu cream was used. The Senate investigating committee later learned that Meadow Gold quietly pulled ice cream other than that previously recalled.

A telephone poll of consumers conducted for Foremost Dairies showed whole milk consumption was down 73 percent, 2 percent down 75 percent, and imitation milk sales up 169 percent. About 16 percent said if the crisis ended they would buy a lot less milk, 8 percent said

a little less, and 70 percent said they would resume normal consumption.

Mid-April brought the fifth DOH recall, this time of some Meadow Gold low-fat cottage cheese with heptachlor residues more than twice the action level. The company's production practices and ethics were questioned, and the company voluntarily pulled all its cottage cheese. Clark again blamed the processor for misleading the State into believing no raw Oahu milk was used in some Class II products. Both Clark and Cayetano called for a second investigation of Meadow Gold, which the company president welçomed. Cayetano claimed the DOH had "put misplaced trust in Meadow Gold" (in Harpham & Hastings, 4/15/82). He again questioned the legality of making skim milk from contaminated raw milk. To avoid further recalls, Clark ordered the processors to reject all violative milk and not use it for skim. Meadow Gold complained about the order, and in his response, Clark questioned why the company had not conducted independent lab tests as had Foremost. Where the DOH had previously concentrated its testing on fluid milk, it expanded its tests to Class II products, including some from the mainland. Again Clark assured that no violative product would reach the shelves but had to qualify that by adding, "that is, assuming my orders are followed" (in Kakesako, 4/14/82).

Meadow Gold officials claimed the recalled cottage cheese was made from the same mix used in a batch previously cleared of contamination. Clark expressed confusion over how a product made from acceptable milk could contain unacceptable heptachlor levels. The "skim milk

syndrome" received attention as a possible explanation. Research found that by skimming contaminated milk to remove heptachlor in the butterfat, the fat remaining had a higher heptachlor concentration than the fat removed. The FDA suggested the EPA re-evaluate the heptachlor action level.

On April 19, the FDA banned Meadow Gold milk from interstate travel because samples taken three and five days earlier showed unacceptable heptachlor levels. Clark requested an expanded Attorney General probe because supposedly the milk had been tested before delivery. The next day, despite test results showing acceptable heptachlor levels, Clark recalled all Meadow Gold products made from Oahu milk and banned its further use of Oahu milk. The armed forces likewise halted purchases of Meadow Gold's fresh and imitation milk. Foremost, whose profile during the whole incident had been low, accepted milk usually sold to Meadow Gold but was careful to avoid a recall. It held the milk until testing was completed, resulting in a fresh milk shortage for a few days. Meadow Gold responded by revealing its offer to allow DOH personnel to monitor the plant 24 hours a day, but that the DOH declined. The company indicated it would sue the State and seek a temporary restraining order to block State action.

When asked if Foremost could meet the increased demand for its milk, its new president, Donald Bender, said his production could increase, but Foremost did not have a large enough market.

> We're at a point where consumers are so confused and concerned that they're avoiding anything in the dairy case except for certain products. . . . We've enjoyed a tremendous increase in imitation milk and juice sales have just skyrocketed. (in Watanabe, 4/22/82)

Two days after its ban against Meadow Gold, the DOH allowed the company to process Oahu milk, but there were implications Meadow Gold's threatened lawsuit may have influenced the decision. The processor agreed to improve its tracing and testing procedures to lessen the chances of violative products reaching store shelves. A week after the ban, Oahu-supplied Meadow Gold products were again available. In attempts to restore sales, the company announced the expanded testing measures, a consumer-information program, and plans to import about 500 cows from the mainland and other islands.

Because of public concern about Oahu-produced milk, Foremost shipped in milk from Hawaii. Total April imports by both companies were 12,733 gallons. Skim and 2 percent milk were not being produced on Oahu.

The pace of events slowed in May. The Senate investigation continued, and for one week, the Navy flew in five milk shipments for its commissaries. Meadow Gold flew in cows from California with much publicity and dropped its milk prices for about two weeks. Losses to dairymen from dumped milk exceeded $600,000 ("Dairy Farmers' Loss," 5/14/82), and the Governor declared an economic emergency so they could receive aid.

By mid-month, processors claimed public concern was still depressing sales. Before the Senate investigating committee, Health Director Clark claimed Oahu milk was safe to drink and explained precautions being taken to ensure milk safety. He admitted that the DOH, Department of Agriculture, the UH, and the FDA were unprepared to deal

with the crisis. "There was a breakdown," he said (in Harpham, 5/21/82). Deputy Health Director Koizumi said, "What we were not prepared for was the need to get information out to the public. . . . We were hesitant, we didn't know how to handle it. Had we been more aggressive in getting information out there would have been fewer problems" (in Harpham, 5/21/82). From the hearings, it seems Foremost took more precautions than Meadow Gold. The situation for Meadow Gold improved when the FDA ended the ban on interstate shipments of its products, and the military resumed purchases. Dairymen expressed concern that consumption habits may have changed due to the crisis.

By month's end, seven of the island's 16 dairies were cleared, skim milk returned to store shelves, public confidence was slowly returning, but imitation milk sales were still up. Supply and demand were about balancing out, but the periods of peak demand and supply did not always coincide. Some spot shortages were reported. The discovery of contaminated green chop as early as April 1981 initially attracted little attention but was to later develop into a new phase of the controversy--determination of the duration of public exposure to heptachlor.

Early June brought another recall, this time a federal recall of 1.5 million cans of tuna packed in Honolulu for improper canning. By mid-June, nine out of 16 dairies were cleared, and while sales were lower than usual, the milk commissioner felt consumer confidence was returning. Attention began shifting to the Department of Agriculture

and the supply situation rather than the health department and milk safety.

Another farm was cleared in July, and supply exceeded consumption. The milk commissioner anticipated financial problems for Oahu dairymen in August or September if sales did not improve.

As the Senate investigating committee held hearings, more about the crisis was revealed. Cayetano accused Meadow Gold of deliberate use of contaminated cream and other illegalities. The company harshly criticized the tactics used in the committee's investigation. Foremost was praised for voluntarily pulling products and halting the skimming of unacceptable milk. Both processors claimed the DOH advised them such skimming was permissible.

3.1.3 Renewed Controversy Over Duration of Exposure and Appropriate Action Level

The controversy entered a new phase in late July. Gubernatorial candidates tried to use the incident to their political advantage as evidence of the incumbent's poor leadership. Lt. Governor Jean King disclosed a UH report indicating unacceptable heptachlor levels in milk as early as April 1981, which she claimed Health Director Clark tried to cover up, and which the Attorney General kept from Sen. Cayetano's investigation. Clark denied such an attempt, but length of exposure became an issue since the DOH originally believed milk was contaminated only four months before the first recall.

In the first half of August, milk sales began to rise, and newspapers reported heavily on the length of exposure and possible

lowering of the action level. The political aspects of the issue became less salient as questions of milk safety were again raised. The EPA and an independent lab confirmed the UH finding that Oahu milk contained unacceptable heptachlor levels in April 1981. Originally, officials believed the exposure was only short-term, and ill effects were downplayed. Now, the serious effects and cumulative build-up of heptachlor in the body were reported. With the finding that Oahu consumers, especially children, were exposed for about a year, sub-chronic liver damage was considered a real possibility, and the EPA considered lowering the action level.

The findings of longer contamination were an embarrassment to the health department, which detected no violations in its July 1981 tests. Clark attacked the findings and defended the DOH lab, generating more publicity about the contamination. Five months earlier, a consumer had informed Sen. Cayetano that she had found some frozen milk bottled in July and August of 1981 in the bottom of her freezer. The Senator referred her to the health department, but only in late July did the DOH test the milk and find no violative heptachlor residues. Confusion resulted since milk was apparently contaminated in April 1981 and January 1982, but not in July 1981. To add to this, the FDA confirmed that acceptable heptachlor levels were present in the July milk, though three times higher than the DOH found. It was later discovered that the DOH knew in April 1982 that Meadow Gold ice cream made in May 1981 had heptachlor residues very close to the action

level. Cayetano criticized the department for not disclosing such findings to help determine the length of exposure.

As EPA officials visited Oahu in mid-August, the question of the appropriate action level was further highlighted. After meeting with Clark, EPA Director of Pesticide Programs Edwin Johnson tried to calm public fears about heptachlor, though he still expressed concern for infants. Johnson acknowledged that determination of the action level would have to consider the economic repercussion on the dairy industry. The DOH said it would follow the action level set at the federal level. To resolve the question of contamination in milk bottled in April 1981, the EPA submitted its sample to another independent lab, which later confirmed the contamination.

In the meantime, 12 dairies met the action level of 0.3 ppm, but sales had not reached pre-recall levels. Dr. James Koshi: "The public has yet to be convinced that the milk is now safe to drink" (in Watanabe, 8/2/82). To help restore consumer confidence, Meadow Gold, now under Raymond Jarman, established a new milk hotline, a speakers bureau, and an informational brochure, but refused to disclose to the Senate committee how its ice cream was made.

On August 17, after releasing findings that Oahu infant livers were unaffected by heptachlor, Clark officially declared the end of the heptachlor crisis. He again assured the public that milk was safe, that monthly monitoring of milk for pesticides would continue, and that 95 percent of milk products contained less than half the permissible level of heptachlor. Cayetano disagreed with Clark's decision to close

the issue. Some health experts recommended that consumers still refrain from milk consumption.

As August closed, attention began to shift to possible federal aid for the dairymen and the political implications of the incident. The Honolulu Advertiser released results of its poll taken mid-month when the EPA-DOH dispute was publicized and the appropriate action level was debated. Fifty-four percent of those sampled felt "pretty sure" that milk was safe, but 40 percent were not sure. Thirty-five percent said they were drinking less milk; milk sales were down by 20 percent.

Schools opened in September serving fresh 2 percent milk, as usual. Papers reported the anticipated EPA recommendation to lower the action level and its effect on island milk supplies. No shortages were expected since sales were still below normal and acceptable milk was being dumped. All but one dairy were cleared, and both processors were careful to accept milk sufficiently below the action level to minimize the possibility of a recall. As a result of the Department of Agriculture's pesticide use/misuse investigation, the State cited Del Monte and issued a warning to Dole for premature harvest of fields sprayed with the pesticide.

September 10 brought EPA's recommendation to the FDA to lower the action level to 0.1 ppm. Less than 1 percent of mainland milk would have been unacceptable under the new standard, which provided adequate protection for persons older than four months. An action level of 0.05 ppm would provide adequate protection for all persons, but about 2 percent of mainland milk would exceed the level. Health

Director Clark said he would act after the FDA accepted the recommendation but that no recall would be issued. It was unclear whether commingling of acceptable and unacceptable milk would be allowed; it was not in April 1982. One editorial noted that commingling could increase doubts about milk safety. The EPA also revealed that low-level contamination of Oahu milk was likely from October 1980, or 18 months before the first recall. The possibility of subchronic liver damage again received attention.

Around mid-month, another failure by the DOH to protect the public was disclosed. A few months earlier, violative levels of the pesticide endosulfan were found in Oahu watercress after the crop had been sold. The DOH gave the public no notice of its findings.

On September 21, the FDA lowered the action level to 0.1 ppm, claiming the length not the amount of heptachlor exposure was the problem on Oahu. Both processors acted immediately, and the DOH lowered its action level the next day upon receipt of the FDA's official notice. Milk sales were still below supply; milk from two dairies was not being processed because of inadequate demand. The DOH stepped up testing.

No commingling was allowed, and this apparently surprised the processors who had earlier predicted no shortages. By September 24, Foremost was unable to meet demand, and by September 27, with some of its milk diverted to Foremost, Meadow Gold too had trouble supplying adequate amounts of milk. Schools were supplied with imitation milk. Clark quietly acknowledged that milk was contaminated in April 1981,

after the EPA tests showing such contamination were confirmed. By September's end, more watercress was seized for endosulfan contamination, and a well was closed for contamination by dibromochloropropane (DBCP).

Principal October news events included a recall of Tylenol in Hawaii, and the Senate investigation hearings. The State claimed the pineapple companies allowed premature harvest of their fields. It was announced later that even four years after application, heptachlor residues could be detected in green chop. Most damaging to Foremost's reputation was the revelation that on March 25, it did not recall possibly contaminated yogurt, but quietly sent salesmen to all outlets to buy it back. Sen. Cayetano criticized the company for not publicly recalling the product. Citing the attitude taken to the discovery of cyanide in Tylenol, Cayetano said, "What we hope to get is that kind of attitude to any contamination" (in Harpham, 10/6/82). The press again reported the Senator's criticism of the DOH for its lack of promptness and good management in handling the situation and that economic considerations were of greater concern to it than the public interest.

No related items were reported in the November newspapers. After importing about 1,800 gallons of milk in October, none was imported in November. The milk crisis was not a sufficient embarrassment to Gov. Ariyoshi to prevent his re-election. Shortly before Thanksgiving, Hurricane Iwa struck and Oahu suffered substantial damage.

3.1.4 Subsequent Contamination

On December 8, antibiotics were detected in unacceptable amounts in Meadow Gold milk. About 6,000 gallons of skim and recombined milk were "voluntarily" recalled before the DOH ordered it. No further shortage resulted as safe milk supplies were quickly restored. The next day, Meadow Gold whole and 2 percent milk were found to contain excess antibiotics but had already been pulled from the shelves. The DOH investigated the incident, especially trying to determine how recombined milk, supposedly not made with any Oahu ingredients, could contain antibiotics. Meadow Gold President Jarman claimed the contamination occurred in the plant's milk lines. Foremost, with a better testing program than Meadow Gold, dumped contaminated milk before it entered the plant. Despite DOH clearance of Foremost, the company still received many calls about the contamination and anticipated lower sales. Milk sales had yet to recover to pre-heptachlor-contamination levels.

By December 11, antibiotics were cleared from the milk supply, but Meadow Gold continued to face close State scrutiny. DOH officials considered further penalties against the processor but thought the recall probably hurt the company more than any fine. The incident was kept alive in the press since the contamination source could not be identified. To Meadow Gold's chagrin, it was finally determined to be its own farm.

Near the holidays, it was discovered that nonviolative levels of heptachlor had been detected in Meadow Gold imitation milk in

mid-November. Skim milk could be used in imitation milk, so the DOH began consideration of label changes for the product. Health Director Clark also recommended that fines for violators of the State's milk regulations be stiffened from a maximum of $500 to a minimum of $2,500 per violation and that each violation be considered a criminal offense, not a misdemeanor. The health director suggested the processors be required to test milk before it is received into the plant. Milk Commissioner Roy Matsuura, later accused by the Senate committee of compromising his duty by his dealings with Meadow Gold, retired.

The new year brought increased milk supplies. Schools resumed serving fresh 2 percent milk, but consumer confidence had yet to be restored. The proceedings of the Senate hearings were reported throughout January. Sharp criticism was directed at State officials and Meadow Gold for not making public health their highest priority. Milk on the island of Hawaii was recalled once for antibiotic contamination. On January 29, a small article announced that Safeway, Inc., had applied for a milk distributor's license to import milk.

3.1.5 Assigning Responsibility

In February, the Senate investigating committee released its findings, which were critical of both federal and State agencies and the milk processors, among others. The FDA and EPA allegedly failed to ensure public health by allowing heptachlor use in Hawaii without specific tests to determine the possible health effects from its use on the pineapple crop. The pineapple companies were found negligent for not monitoring heptachlor application and harvesting of fields. The

DOH was accused of being more interested in avoiding recalls and public criticism than in protecting the public. Allegedly, it failed to quickly develop a plan of action, was too slow in its recalls, and sometimes waited for test results before pulling products known to be made from contaminated milk. The DOH was criticized for allowing processors to use contaminated milk to make skim milk. Clark did not plan to discipline DOH officials criticized in the report because they helped the State through the crisis. The committee accused Meadow Gold of engaging in illegal acts, including the intentional use of contaminated milk for products beyond just skim milk, and the destruction of pertinent production records. The company denied some charges and claimed others were based on "unverifiable assumptions" (in Watanabe & Mayer, 2/3/83). The Attorney General was charged with poorly conducting its Meadow Gold investigation and was accused of justifying the health department's mistaken advice allowing contaminated milk to be skimmed rather than correctly interpreting the law. In general, "Although the heptachlor contamination crisis may have been caused in large measure by the activities of State officials, much of the blame for its intensity and duration must be placed on the private sector, particularly Meadow Gold" (Hawaii Senate, 1983).

Among other recommendations, the committee suggested that the State Legislature:

--stiffen penalties to deter pesticide misuse,

--require better pesticide-use records from applicators,

--transfer responsibility for pesticide monitoring from the Department of Agriculture to the DOH, and

--provide the DOH the authority to acquire pertinent information concerning possible food contamination.

The Governor was exhorted to direct State agencies to:

--review business contracts with Meadow Gold and offer State contracts to more reliable suppliers,

--appoint a special prosecutor to prosecute Meadow Gold for use of contaminated milk and Foremost for using contaminated milk to make skim milk, and

--obtain legal advice from the Attorney General and not offer uninformed legal opinions.

It was recommended that the DOH:

--impress on its staff its primary responsibility to protect public health, not industry,

--review and improve its testing program,

--routinely test animal feeds treated with pesticides, and

--announce all recalls ordered by the DOH.

Also in February, after sampling breast milk from 166 mothers, the findings of the UH Pesticide Hazard Assessment Project were released. Almost 90 percent had levels too high for infants under four months, and about 60 percent had levels over the 0.1 ppm action level. The State Legislature tried to prevent future occurrences of feed contamination by giving the agriculture department authority to test all animal feed. The DOH requested the power to inspect or seize

records of a company suspected of producing an adulterated or mislabeled product.

With the completion of the Senate investigation and Safeway's bid to enter the market in the background, the public health aspects of the issue began to fade. First, though, Oahu consumer and environmental groups sued both processors for $250 million each for breach of contract by selling contaminated milk. Among other demands, the groups sought a register of infants born from October 1980 to October 1982 and their health monitoring until the age of 18, a medical expense fund for children's illnesses due to heptachlor exposure, punitive damages of $1,000 per milk purchaser, and weekly publication of heptachlor levels in the processors' products.

In mid-March, Real Fresh, Inc., a California producer of sterilized milk, won the right to a federal court hearing to challenge Hawaii's authority to restrict interstate milk trade. The legislature killed a bill mandating an eight-day shelf life for fluid milk, which was introduced to help restore consumer confidence. The bill would have effectively killed any attempt to ship fresh fluid milk from California since the transit is five to six days. Oahu processors voluntarily set shelf life for their fluid products at 10 and 12 days. Milk sales, growing slowly, were still down, and acceptable milk was being dumped when Meadow Gold unveiled its fluid promotion campaign. As part of a national marketing program introducing a new carton, the company placed full-page advertisements in the papers for four weeks.

Toward the end of March, Safeway's application received more attention. As the two processors were threatened with a union strike, Safeway officials admitted they applied for the license in part because of the contamination incident and said they would offer Lucerne brand milk for 10 to 15 percent less than local milk. They foresaw supplying about 10 percent of Oahu's needs.

3.1.6 The Safeway Controversy

The latest phase of the milk issue, protection of local dairies, spilled over when the Board of Agriculture infuriated many consumers by announcing its intent to deny Safeway's application because it was "not in the public interest" (in Harpham, 3/31/83). The Board cited destructive competition and claimed the market was adequately served since acceptable milk was still being dumped daily. The number of milk-related letters to the editor of both papers jumped from zero from November through March to 17 in April, overwhelmingly in favor of Safeway imports.

In response to the Board's intent to deny the license, Safeway requested a public hearing. Despite reports of traces of DDT in Oahu milk, and heptachlor in island wildlife, Gov. Ariyoshi asked Safeway to use Oahu milk in its Lucerne brand. With milk sales still low, Ariyoshi asked the processors to operate more efficiently. Foremost considered importing milk from California and introduced gallon containers for whole, 2 percent, and imitation milk, and orange juice. Fresh milk specials were offered, cutting prices from $1.68 per half-gallon to $1.54. By the end of April, specials continued, but so did

dumping of acceptable milk. When an organization named Friends of Oahu Children asked the Governor to allow milk importation for health reasons, Ariyoshi tried to "dispel the notion that Mainland milk is clean and local milk is not" (in Harpham & Oshiro, 4/20/83). He also offered to make DOH test results public on a regular basis. The legislature voted to fine those responsible for food-safety violations a maximum of $10,000 and gave the DOH power to seize records pertinent to possible food contamination or mislabeling.

May brought news that milk from all dairies was below the action level, but dumping continued. The Hawaii Consumers' League was formed and began petitioning to pressure the State to approve Safeway's application for reasons of health, price, and freedom of choice. Seventy-five people attended its first meeting. Of the 32 relevant letters to both papers, two to one favored Safeway. The League's president wrote:

> Few of that segment of the public (about 27 percent) which has lost so much confidence in the local milk industry as well as in the government's ability or willingness to protect the consumer interest will ever buy the local product again--even in a redesigned package. However, many will tell you they are tired of powdered milk and want an alternative fresh source. (McMurdo, 5/6/83)

Foremost introduced "Dairyland," a private label for Foodland stores, with a price 5 percent less than Meadow Gold or Foremost milk. Milk specials continued and merited mention in an editorial.

The Fresh Milk Industry of Hawaii, consisting of dairymen and processors, took the offensive against Safeway by placing an advertisement, not in Hawaiian papers, but in the newspapers of Oakland,

California, where Safeway's headquarters are located. The ads questioned Safeway's conscience for trying to destroy the Hawaiian dairy industry. Dr. Koshi, now executive director of the dairy organization, claimed Safeway's imports could lead to the industry's demise, leaving the islands solely dependent on an uncertain supply from the mainland. Other stores also applied for licenses to import milk if Safeway were allowed. Koshi claimed the market was adequately supplied because dumping of acceptable milk continued.

By mid-May, an initial $6.4 million in federal aid from the Dairy Indemnity Program was made available to Oahu dairymen, who lost an estimated $8.5 million. Later in the month, Safeway ran a full-page ad in the Oahu papers asking, "Who's milking the Hawaiian consumer?" and implying a tradeoff between 500 jobs and 5,000 babies. A poll conducted for Safeway revealed that 62 percent favored Safeway's application although more than half believed that local milk was safe. Of the 32 relevant letters to the editor printed in both papers, more than two to one were in favor of milk imports.

June was appropriately designated "Dairy Month" by the Governor since the milk controversy was discussed in the papers almost every day. The Fresh Milk Industry of Hawaii began a series of weekly ads to answer consumer questions about milk safety, milk supplies, and the need for local industry protection. Several dairymen sued Safeway for $4.5 million for false and malicious claims about the Hawaiian industry. Despite rumors of heptachlor, and mention of salmonella in Californian milk, the Hawaii Consumers' League gathered 12,000

signatures in five weeks. Before the first week of June ended, though, the unions employed at Safeway went on strike through June and into the summer. The local dairymen's claim of uncertain supplies seemed confirmed. A study by the Hawaii Department of Planning and Economic Development was released, estimating costs to the islands of $33 million if importation were allowed. By month's end, the Hawaii Consumers' League, the Libertarian Party, the 50th State Dairy Farmers' Cooperative, the Oahu Dairy Cooperative, and the U.S. Justice Department requested permission from the Board of Agriculture to participate in the Safeway hearings.

3.1.7 Beyond the Study Period

Since June, events have evolved more slowly. In late August, the Board of Agriculture granted Dairymen, Inc., a license to import UHT milk. In early September, before its court case challenging Hawaii's restriction of interstate milk trade, Real Fresh, Inc., was granted a similar license. The constitutionality of Hawaii's Milk Control Act was still unresolved.

From September 28 to October 17, the Board of Agriculture heard testimony regarding Safeway's application. As the local industry claimed imports would lead to dependence on uncertain external milk supplies, unions at both processors went on strike. Dumping and spot shortages occurred as management tried to operate the plants. According to one industry official, it was only in December 1983, 22 months

after the first recall, that milk sales returned to pre-contamination levels.

Early in 1984, Chairman Jack Suwa of the Board of Agriculture surprisingly announced he favored granting Safeway's request. Apparently the controversy was re-ignited, and the hearings were to be re-opened. Before they were, though, a federal judge in Hawaii ordered the State to grant Safeway a distributor's license, and in May, fresh California milk was available to Oahu consumers. The Governor was considering signing legislation mandating a 10-day shelf life. The Oahu milk controversy is far from settled.

3.2 Legalities After the Incident

The legalities surrounding the incident reflect the confusion stemming from it. One group of consumers sued the State and processors for ill effects supposedly suffered from heptachlor exposure. Another sued the State, Gov. Ariyoshi, and Health Director Clark to enforce the zero heptachlor tolerance level, while another group sued the two processors for half a billion dollars for selling contaminated milk. The dairymen sued the pineapple companies for selling contaminated feed, the State for causing confusion in the market, and the heptachlor manufacturer (Velsicol Chemical Corp.) and its distributor (Brewer Chemical Corp.). The pineapple companies sued the State and Velsicol, and counter-sued the dairymen's Green Feed Coop. The company that insured the Green Feed Coop against such lawsuits itself sued the Coop to escape liabilities. Meanwhile, Real Fresh, Inc., had taken the State to court challenging the constitutionality of the Milk Control

Act, and Safeway was sued for defaming Oahu dairymen. As of June 1983, just about every party involved faced legalities. Total awards could be over $620 million. Value of sales from Oahu dairies were about $25 million the year before the crisis.

3.3 Advertising Response

The newspaper advertising strategies pursued by the two processors and their rivals differed markedly. Meadow Gold advertised much more than Foremost, perhaps because the former had a larger milk supply and more unfavorable media coverage. Rivals stressed the wholesomeness of their products that were not made in Hawaii.

Meadow Gold responded three days after the first recall with a full-page ad announcing a new milk supply and stating that all Meadow Gold milk on grocer shelves had been approved by the DOH. Two days later, Foremost's full-page ad claimed its milk was "good and wholesome," but if unavailable, "Ditto," Foremost's imitation milk, was just as good. A week after the first recall, Meadow Gold blitzed the week's papers with ads describing its imitation and recombined products, even after its buttermilk was recalled.

In early April 1982, Real Fresh, Inc., began a three-week campaign of weekly ads stressing that Real Fresh milk, available in cartons in the commissaries and cans to the public, was "sterilized for [consumers'] safety" and free of pesticides. "KLIM," Borden's dry, whole milk, also stressed its wholesomeness and added, "Drink to your health, Hawaii."

Early in May, Meadow Gold again promoted its imitation products. Later in the month and through June, new ads with coupons introduced a promotion where, by buying a half-gallon of milk, the coupons could be used for savings on other products.

August brought Carnation's annual "Healthy Baby Contest," which ran through October.

With milk shortages in late September 1982, Foremost re-introduced its ad assuring consumers of the wholesomeness of its fresh and imitation milk, and offering coupons for the latter. No ads were printed from the end of October through February.

Almost on the anniversary of the first recall, and about six weeks after the Senate investigating committee findings had been released, Meadow Gold introduced its new carton with weekly full-page ads saying, "Freshness Never Tasted Better." For the purchase of two half-gallons of fresh, whole milk, the consumer could get one free half-gallon of fruit or other drink. The campaign lasted about a month.

The end of June 1983 brought ads and coupons for Foremost's gallon container, which had been on the market already for about two months.

Interviews with advertising directors of the four commercial Oahu television stations indicate that after the initial recalls, processors promoted imitation milk, fruit drinks, and some processed dairy products. At some times, though, when unfavorable news was reported, both companies completely cut television advertising,

creating confusion for the stations. Some directors felt no effective countermeasures were taken by the companies.

CHAPTER FOUR

THEORY AND METHODOLOGY

With this background of the Oahu milk market and the contamination incident, the theory and methodology of this study may be developed.

4.1 Adjustments to Standard Theory

Standard economic theory holds that quantity demanded is a function of the product price, price of substitutes, income, tastes, and preferences. Implicitly assumed is perfect knowledge and maximizing behavior on the part of the consumer. In a study of consumer reaction to food contamination, these assumptions are especially doubtful. Bartlett (1973) stated that imperfect knowledge creates uncertainty and the opportunity to influence decision makers by subsidizing information. Cox (1967) found that consumers with high risk perceptions, as could be expected following a contamination incident, seek information to reduce that risk. It was assumed that the information they find will affect demand.

Heiner (1983) stated that people cope with uncertainty by developing behavioral rules and patterns to use in recurrent situations. As the individual follows habits, opportunities to maximize utility are overlooked. The relevance for this study is that

consumption habits are used to reduce risk and uncertainty; brand loyalty is an example of such behavior. Heiner claimed that such rule-governed behavior will change when the reliability of a new action to improve performance exceeds a minimum level of reliability. Applied to food contamination incidents this implies that habits may change when the risks of consuming a product under question exceed a certain level. Folkes (1984) implied that negative and unexpected events may lead to re-evaluation of purchasing behavior. Thus, one would expect a threshold of negative information before the consumer changes consumption.

4.2 Awareness of Contamination and Mediating Factors

A key assumption of this study is that awareness of contamination, not contamination itself, affects consumer response. However, awareness alone may not effect a change in behavior. After a contamination incident some persist in consuming food of questionable safety. Hence, awareness is apparently mediated by several factors. Source credibility is one. Sternthal, Phillips, and Dholakia (1978) defined credibility in terms of expertise and trustworthiness. They cited evidence that "highly trustworthy and/or expert sources produce a more positive attitude toward the position advocated than sources that are less trustworthy and/or expert . . . [and] highly credible sources often induce more behavioral compliance than do sources having less credibility" (p. 287). Weinberger and Dillon (1980, Table 3) presented evidence that implies purchase intentions are more strongly affected by

unfavorable product information from an independent testing agency than favorable information from a trade or professional association.

Aspects of the individual as receiver of information affect his/her reaction to it. Sternthal, Phillips, and Dholakia (1978) concluded that audience predisposition affects the influence of source credibility. "When an audience is favorably predisposed toward an advocacy, a low credibility source will induce greater persuasion, whereas when an audience is negatively predisposed, a highly credible source will be more influential" (p. 298). Following a contamination incident when consumers may not trust the product in question, a highly credible source of information is needed to restore confidence. Locander and Hermann (1979) cited evidence that as the complexity of a situation rises, self-confidence affects the tendency to accept influence. They found that as risk rises, consumers most confident in their ability to make a specific purchase decision rely most on their personal experience and independent sources of information. In the aftermath of a contamination incident as risk perceptions may rise, some individuals will mostly trust their own experience and independent sources of information. Those who are less confident may be more easily influenced and if most of the information to which they are exposed concerns the health hazards of the contaminated product, one would expect sales to fall.

4.3 Specific Response to Negative Product Information and Recalls

Studies of the attitudinal and behavioral effects of negative information are relatively recent. Cusumano and Richey (1970) determined that negative information given to subjects about the character of a stranger has a greater effect on evaluations of the stranger than positive information. Further, the order in which information is given (first negative, then positive and vice versa) has little effect on the final evaluations. They concluded that the effect of negative information overwhelms that of positive information. Richey et al. (1975) again presented favorable and unfavorable information about a stranger to subjects who then rated his character. Results were that a single negative behavior counteracts five positive behaviors; the stranger was rated the same when five positive and only one negative statement were made of him as he was when five positive and five negative statements were made. Thus "one slip-up" is all it takes to influence an individual's reputation among those who are not familiar with him/ her. Weinberger and Dillon (1980) applied such work to consumer purchase intentions in response to favorable and unfavorable product information. They found that unfavorable ratings have a disproportionately greater impact than favorable ratings.

With respect to product recalls, Mowen (1979, cited in Mowen, 1980) claimed to have conducted the first experimental investigation into consumer perceptions of product recalls. He found that a company that makes a series of recalls is held more responsible for the defect than a company that makes fewer recalls. Similarly, the longer a

company delays in making a recall, the lower are perceptions of its concern for consumer welfare. Further, the extent of injury resulting from the defect also influences perceptions of the company and intentions to purchase a replacement product. In his similar 1980 study, Mowen surveyed a sample of secretaries, homemakers, and members of the League of Women Voters after presenting them with information about recalls by Corning Ware and a fictitious company. The more familiar, reputable company was held less responsible for its product defect than the fictitious company. Surprisingly, when a company voluntarily recalled its product (while the Consumer Product Safety Commission (CPSC) was still studying the matter) it was held more responsible for the defect than when the CPSC recalled the product. Mowen hypothesized that when the CPSC recalls the product, it (somehow) shares responsibility for the defect.

Mowen, Jolly, and Nickell (1981) improved the external validity of Mowen's earlier studies by surveying a random sample of people for their perceptions of four companies, Ford Motor Company, Firestone, Inc., Corning Glass Works, and Conair, Inc., which recalled products. Different factors related significantly to perceptions of different companies, suggesting mediating factors influence perceptions of individual companies. Ford and Firestone's social responsibility (or lack thereof) was related to perceptions of those companies. Other factors found to be related to Firestone were the consumer's knowledge of the product recall, the defect danger, and whether any other tire companies made recalls. Perceptions of Conair were related to the danger of the

defect and corporate responsibility for it. No significant effects were found to explain perceptions of Corning Glass, which Mowen explained was due to either the small number of respondents aware of its recall or its good reputation. Mowen claimed length of time to recall, not found significant here, was indirectly related to consumer perceptions through impression of corporate social responsibility. He did not reconcile the finding that the number of previous recalls was not significant here, though it was in his 1979 work. Mowen and Ellis (1980, cited in Mowen & Pollman, 1982) again presented a fictitious magazine article about a company recall. The severity of injury, number of previous recalls, and length of time to recall influenced perceptions of the company and interest in purchasing a replacement product from it.

Mowen and Pollman (1982) continued the research exposing undergraduate business students to press releases about a recall. The order of release of information was studied. The company that first announced the most severe outcome and later issued less severe warnings was perceived more favorably, and as more honest, credible, and concerned for consumer welfare than companies whose press releases grew more alarming with time. "Messages which were in-role, such that they follow the obvious interests of the communicator, tended to be perceived as less credible and as made for the benefit of the sender and not the receiver" (p. 219).

The above research may be extended to consumer response to food contamination incidents. One would expect that response is

influenced by the severity of the contamination's effect (e.g., botulism in canned food), the company's responsibility for the contamination, the number of previous recalls, and the company's social responsibility, related to the length of time to recall. Announcing the worst possible outcome first enhances the company image and may limit sales loss in the long run. If government is responsible for overseeing food safety, questions of its responsibility for the contamination and concern for consumer welfare may influence perceptions of the food product and hence sales. These factors may be mediated by the credibility of the source of the information and consumers' predisposition, risk perceptions, self-confidence, and other factors.

4.4 Mass Media and Interpersonal Communication Effects on Awareness

Awareness of product quality is gained through the mass media and interpersonal communication. In the field of journalism, it is believed, though not without controversy, that the effect of mass media on the public is to set the agenda of issues which people consider. The agenda-setting hypothesis states that the "media may not be especially powerful in telling people what to think, but they can be quite successful in determining what people will think about" (Cohen, cited in Chaffee, 1980). "Newspapers clearly state the value they place on the salience of an item through headline size and placement within the newspaper. . . . Agenda-setting asserts that audiences learn these saliences from the news media, incorporating a similar set of weights into their personal agendas" (McCombs & Shaw, 1977). People take a cue

from the priority given an issue in the media in determining the issue's priority for themselves. Thus when much attention is devoted to a contamination incident, people will consider the contamination. Some may discount it, but they will consider it.

A weakness of the agenda-setting hypothesis with respect to issues of product quality is that much of the evidence supporting it stems from the effect of media coverage of political issues on persons' priority attached to those same issues. However, one study by Bloj (cited in Sutherland & Galloway, 1981) suggests that the agenda-setting hypothesis also applies to product quality perceptions. He found a correlation between the prominence of air crash coverage, a fall in ticket sales, and an increase in sales of flight insurance.

A second avenue in which consumers are exposed to news about product quality is through interpersonal communication. Eugene Shaw (1977) found evidence implying that issues given prominence in the media are also those issues discussed among people. Again, though, his study concerned political coverage and discussions leading up to the 1972 presidential campaign. Arndt (1967) found that word-of-mouth advertising among homemakers does affect purchases and that those with the highest risk perceptions are most affected by word-of-mouth exposure. Therefore, following a contamination occurrence, consumers may gain awareness of the incident through the mass media, and this may be reinforced by interpersonal communication. Hence, studying media coverage may closely reflect total consumer awareness of food contamination.

4.5 Consumer Response to Health Warnings and Contamination Incidents

Given that food contamination incidents have gained attention principally after the 1973 PBB incident, it is not surprising that there are few studies of consumer response to food contamination. These studies are scattered among the literature of the marketing, consumer research, and agricultural and environmental economics professions. They either employ a dummy variable or a variable quantifying media coverage of the health threat to examine the effect of a health warning on product sales.

4.5.1 Studies Without a Quantified Media Variable

The first known work (Brown, 1969) dealt only with a possible change in cranberry price elasticity following the 1959 Department of Health, Education, and Welfare announcement that cranberries could contain residues of the herbicide and suspected carcinogen amino triazole. The pre-Thanksgiving announcement was particularly untimely for producers. From 1957 through 1962, 300 Atlanta, Georgia, families recorded weekly food purchases. Brown hypothesized that since advertising decreases price elasticity, product contamination or adverse advertising would increase it. Per capita purchases regressed on average price, age of homemaker (a one-four dummy variable), and per capita income in periods before, during, and after the scare revealed no significant change in elasticity. Per capita purchases did fall 26 percent in 1959 but regained the 1957-58 level during 1960-62. The

specific extent and duration of reduced purchases are unknown since it was not a study objective. Brown suggested that industry advertising may offset changes in demand elasticity.

Hamilton (1972) examined the relative effects of advertising and health warnings on cigarette demand from 1925 through 1970. Annual per capita cigarette consumption by persons over 13 years of age was regressed on measures of price, per capita income, and advertising. Three zero-one dummy variables were also used, representing, respectively, the first major cigarette health report (1953), the 1964 Surgeon General's report, and the beginning of the significant amount of broadcast anti-smoking messages in 1968 mandated by the Federal Communication Commission's Fairness Doctrine. Hamilton found that the health scare decreased consumption more than advertising increased it. An interesting point is that the 1968 dummy (representing anti-smoking broadcasts) had a greater effect than the single 1964 Surgeon General's report, which in turn had a greater effect that the initial report. If true, then this would illustrate the relative impacts of a one-time announcement compared to repeated exposure to a health warning. This conclusion may not be drawn, though, since the greater impact of the 1968 dummy variable may reflect carryover effects from the 1964 warning and other factors.

Witt and Pass (1981) conducted a very similar study on cigarette consumption in Great Britain. Three major health warnings were represented by three dummy variables. The authors found that the health scares reduced consumption so much (3 to 7 percent) that

advertising expenditures would have had to double to compensate for the loss. Using annual data to determine the duration of the health scares, their demand equation was estimated three times with the dummy variables taking the value of one only in the year of the respective health warnings, also in the year following each health report, and in the year of the warning and two subsequent years. The authors concluded the health warnings had a two-year lag. This is an improvement over Hamilton's work, whose dummy variables retain a value of one for every year following the respective health warning. However, Clarke (1976) stated that the duration of advertising's effectiveness is overstated in models using annual data and that advertising's effect does not last more than a year. Thus, a two-year effect on sales is questionable if a health scare is perceived similarly as advertising. If the negative information from a health scare is weighted more heavily than advertising information, as may be the case, then a two-year lag is possible.

Hoffer and Wynne (1975) studied consumer recalls of subcompact cars by examining changes in subcompact market shares of seven domestic and foreign manufacturers. Monthly independent variables included own price and advertising, the differences between own price and that of competitors, the differences between own advertising and that of others, and the number of recalls. Each safety-related recall was assumed to be of equal weight; attempts to quantify media coverage "proved to be highly subjective and unsatisfactory" (p. 214). An instantaneous, noncumulative relationship between market share and the

number of recalls yielded best results. Findings indicated that recalls had an insignificant impact on market shares for all makes except Vega. The authors noted that Vega had slightly fewer recalls (4) than the average make (4.3) but that they were in consecutive months. They contrast this to two other makes with six and eight recalls distributed over the observation period, which suffered no loss of market share due to the recalls.

Vega's loss may be due to heightened consumer awareness from the consecutiveness of the recalls. Strong (1977) recommended that advertisers group advertisements and schedule these groupings close together to maximize effectiveness. Given a flurry of press coverage surrounding the monthly recalls, it is suspected this same effect worked to Vega's disadvantage. Alternatively, the reduction in market share could have been due to consumer perceptions of a greater safety hazard with Vega than with other makes.

4.5.2 Studies Using a Quantified Media Variable

Schuker et al. (1983) examined the effect of the 1977 saccharin health controversy on sales of diet soft drinks. The FDA announced that it would withdraw approval of saccharin use after studies indicated its possible carcinogenicity. Congress placed a moratorium on the ban but required a warning label on saccharin-containing products.

Diet soft drink sales were regressed on diet soft drink price and advertising, regular soft drink price, trend and seasonality variables, and two dummy variables. The warning-label dummy variable

took the value of one after the warning labels appeared. The other took a value of one only in those periods when (print) media coverage exceeded the average of all periods. This major news variable was found superior to other measures of coverage, such as the number of editorials, number of all news items, column inches devoted to the issue, the tone (positive, neutral, or negative) of advocacy about the saccharin ban, and weighted tone (number of items in a period multiplied by the average tone of the items). Findings were that the major news dummy had an insignificant impact on diet soft drink sales while the warning label did explain a reduction in the rate of growth of diet sales. The authors explained media coverage as insignificant due to measurement problems, and that intense coverage of a short duration was expected to have less effect than a continuous warning. Further, in their demographic analysis of the warning's impact, college-educated consumers were first found to reduce consumption, followed by those with young children. The elderly and consumers without a high school diploma did not alter consumption, in spite of the warnings and media attention.

Schulstad and Stoevener (1978) incorporated an information variable in their demand analysis to determine the loss of consumer surplus as consumers altered consumption to avoid a contaminated product. They estimated the effect of information of mercury contamination in pheasants on the average number of pheasant-hunting days per hunter per season, and its impact on the number of pheasant hunters in Oregon from 1950 to 1971. As an information variable, the

cumulative number of articles two years prior to the hunting season was found superior to column inches or number of newspaper articles one year before the season and cumulative column inches of articles two years before the season. All four were highly correlated though.

The information variable was not significantly related to the average number of hunting days per hunter, though it was highly significant in explaining the number of hunters per season. Hence, it appears people will completely exit the market of a contaminated good rather than simply reduce consumption. This must be qualified since there are many substitutes for pheasant hunting. If a product with few substitutes is adulterated, consumers may have no exit option and may limit consumption.

It was estimated that about 17,600 hunters stopped hunting in 1971 because of the contamination information. The percentage of all Oregonian hunters this was is unknown. Aggregate costs to persons who eschewed hunting to avoid contamination were estimated to be $1.35 million.

Swartz and Strand (1981) similarly incorporated an information variable in their model of oyster demand in the Baltimore, Maryland, market. Supposedly, only uncontaminated oysters were sold in Baltimore, but 200 miles to the south, kepone contamination had closed the James River oyster beds and had attracted much media attention. Newspaper articles were rated according to their negative impact on oyster consumption. As a proxy for their likelihood of being read, each story was weighted by the cost of advertising in the space

occupied by that story. Using biweekly observations, the authors found the media variable was significantly related to the fall in oyster sales with a two-month lag, even though the oysters were uncontaminated. Estimated losses to consumers and producers from this imperfect information were about 5 percent of total value of marketing during the news-release period. Losses from a failure of oyster price to rise after the James River was closed, and losses to other seafoods, were not calculated.

The authors also examined the timing of the media coverage and oyster sales and concluded that losses may be affected by when the government announces the contamination. It was estimated that had coverage occurred earlier in the oyster season, losses would have been 25 percent greater, whereas if it occurred near the end of the season, losses would have been similarly reduced. As a policy implication, they stated that if government officials know with certainty that consumption of one product is safe even though a related product is contaminated, losses as consumers attempt to avoid poisoning may be minimized by properly informing the public. (The implicit assumption is that consumers believe government is acting on their behalf, and not to protect the industry.) However, the authors admitted that certainty in the event of a contamination incident may be unlikely. Even with all available information, consumers may still be uncertain about food safety and will change consumption to avoid contamination.

This study is an improvement over other studies in that it allows one to observe the relationship between different levels of

current and lagged media coverage and sales response. It lends understanding to the distributional impacts of a food contamination incident in that even conscientious producers of an undifferentiated product suffer when less ethical or competent producers create a health scare, or when an unforeseen incident strikes some producers. However, their weighting scheme is questionable since the value of advertising on the front page is unknown. Further, the authors only consider those news articles that negatively influenced oyster consumption. Attempts, if any, by government officials to restore confidence in the industry were apparently overlooked. The question remains of the effectiveness of government in restoring confidence once the contamination has been announced.

4.6 Theoretical Statement of the Problem

Following a food contamination incident, consumer tastes, preferences, and perhaps habits change, shifting the demand curve back. If supply is unaffected, as assumed in the studies above, and assuming it is fixed in the short run, the revenue loss to producers is the area P_0P_1ba in Figure 4.1a. If however, product is recalled, shifting supply back as well, several results are possible. If a shortage develops, price is expected to rise, offsetting some of the sales loss due to product dumping. (Area P_2P_0dc compared to loss due to dumping, area Q_0adQ_1 in Figure 4.1b.) If demand falls as much as supply is cut, producer market loss is limited to the amount dumped. (Area Q_0aeQ_2 in Figure 4.1c). However, if demand falls more than supply is reduced (i.e., consumers refrain from purchasing the product), prices will

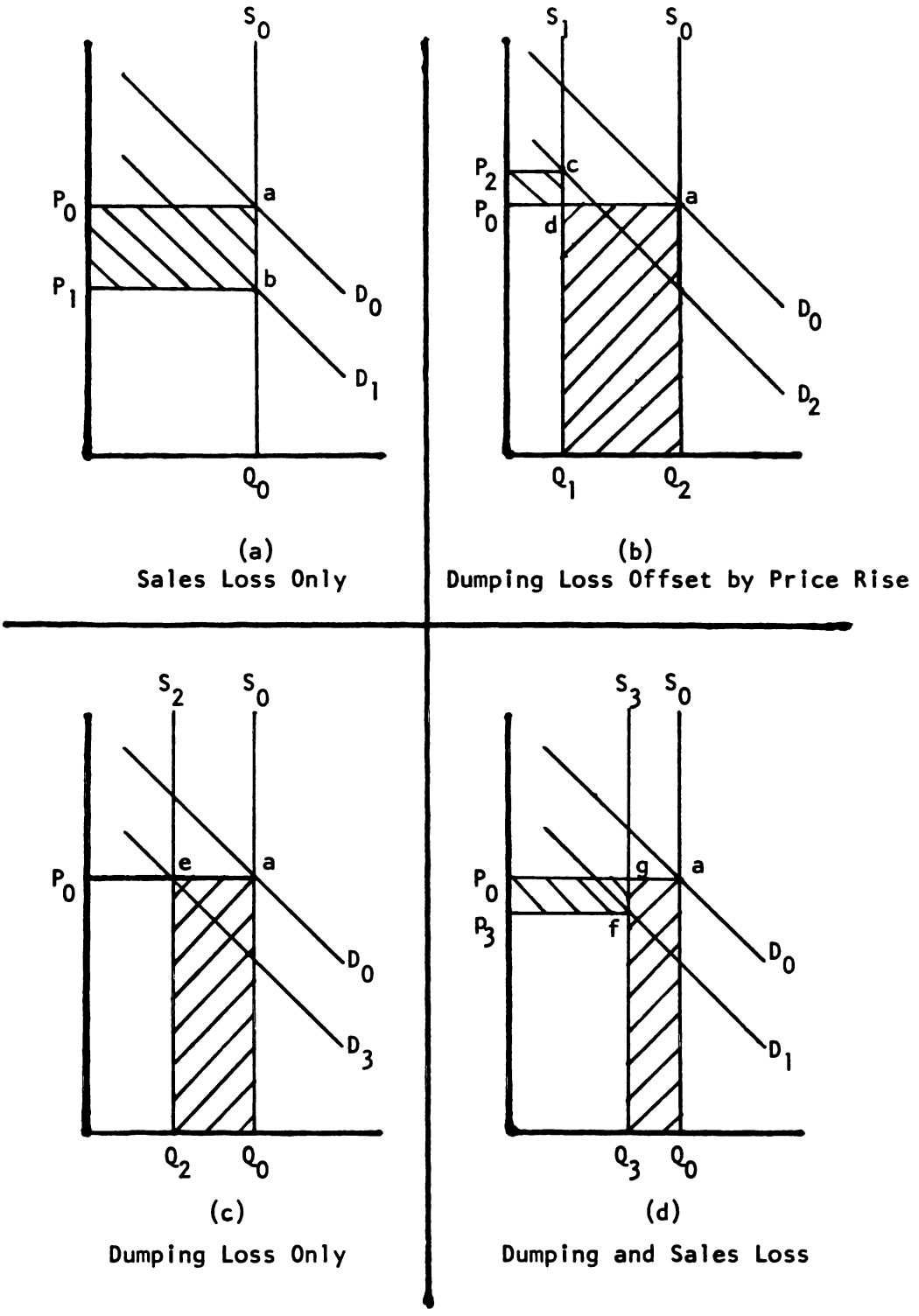
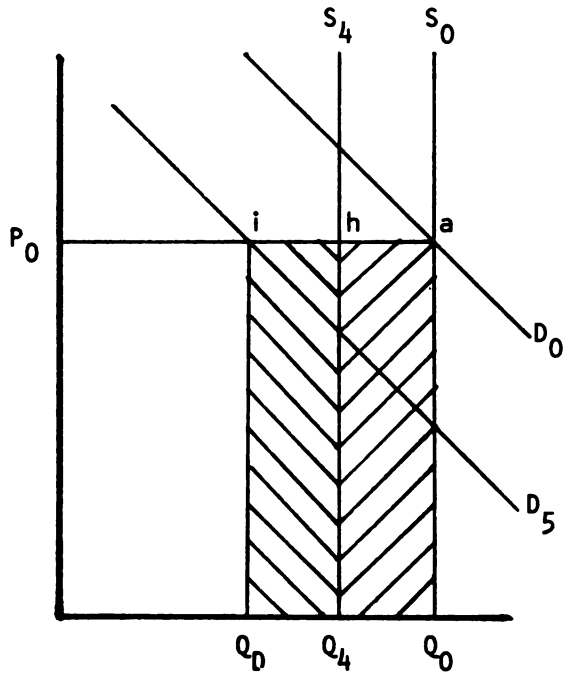


Figure 4.1.--Areas of loss.



(e)

Oahu Dumping and Sales Loss

Figure 4.1.--Cont'd.

fall. Now, in addition to dumping losses, producers suffer the additional loss due to this consumer resistance. (Area P_0P_3fg in addition to area Q_0agQ_3 in Figure 4.1d.) Competitors may attempt to capitalize on the contamination by entering the market and may permanently change purchasing behavior. In the case of a differentiated product, market shares may shift as seen in the case of auto recalls. In cases of industry-wide contamination, consumers may change habits, such as switching from meat consumption to a more vegetarian diet.

Estimating costs to Oahu dairymen requires modification of this theoretical approach. Through Hawaii's Milk Control Act (1967), the producer price received for milk used for fresh fluid use (Class I) is set by the milk commissioner. Over the course of the contamination incident, this price remained constant at $21.09 per hundredweight. Hence, producer costs are two-fold: the value of milk dumped due to contamination (Q_0ahQ_4 in Figure 4.1e), and the value of acceptable milk that could have been used for fresh fluid use, but because of reduced demand was used otherwise (Q_4hiQ_D). The amount of contaminated milk dumped is known; the problem at hand is to measure the losses due to reduced demand.

Only awareness of the contamination will create such a response. From the Witt and Pass (1981) and Swartz and Strand (1981) studies, negative response to a health warning or contamination incident is temporary. One expects consumption to drop as awareness of contamination rises. As the contaminant is cleared from the production system

and reported so by the media, consumption should approach if not return to normal levels. Expected response is shown in Figure 4.2.

4.7 Methodology

Because many factors influence fresh fluid milk consumption on Oahu, an econometric approach is used to determine how sales were affected as a result of the incident. Assuming supply is fixed in each period, a single-equation model was estimated. As did Brown (1969), publicity of the contamination was considered adverse advertising for the industry. In this respect, estimates of advertising's effect on milk demand by Thompson and Eiler (1975b, 1977), Thompson, Eiler, and Forker (1976), and Kinnucan (1983) were particularly useful.

Models of quantity demanded frequently include explanatory variables such as the product's price, prices of substitutes, income, population, demographic and other changes over time, seasonality, and advertising. However, additional factors influence consumption after a contamination announcement and must be included in the model. One of these factors is consumer awareness of food safety, which has three components: food quality (the danger from the contaminant in the product), adequacy of government protection of food supplies from contamination, and hence protection of public health, and the producers'/processors' integrity (their social responsibility and concern for consumer welfare). To reflect awareness of food safety, measures of negative and positive media coverage of food safety were included in the model.

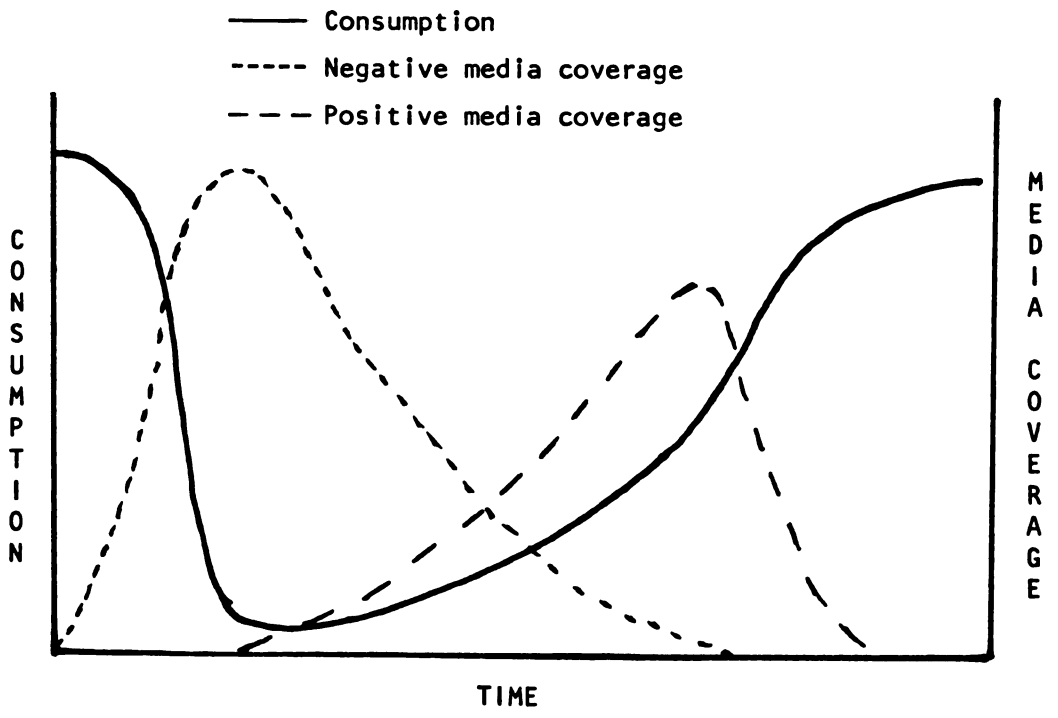


Figure 4.2.--Expected response to media coverage.

The scope of contamination may also affect consumer response, and consumption habits may change. To account for the contamination's scope, the amount of product dumped was included in the model. Initially, one would expect this to be related to supply and have no effect on demand. However, if most product is dumped due to contamination, consumers may suspect even that product allowed on store shelves. As the extent of contamination diminishes, consumers may become less concerned about it. Indeed, as the problem fades, new concerns about the dangers from the contamination may have less effect on consumers because most of the problem has been corrected. This was particularly appropriate in study of the Oahu incident because 95 percent of island cows were contaminated and consumers apparently suspected milk on the shelves too. (Indeed, heptachlor levels were elevated, even though below the allowable or "action" level.) Given that consumers were repeatedly asked to return or dispose of their milk and dairy products, it is possible that the slight downward trend in milk consumption may have steepened as milk consumption habits changed. Hence, factors reflecting this are also incorporated into the model.

The complete model of monthly milk consumption is given below:

$$Q = f(DPM, DPS, DPCPI, Seasonality, TIME, \sum_{i=0}^{m} AD_{t-i},$$

$$\sum_{j=0}^{n} NM_{t-j}, \sum_{k=0}^{p} PM_{t-k}, DUMP, DV, DVTRND)$$

where:

Q = fresh fluid milk consumption per capita per day adjusted for the calendar composition of each month,

DPM = retail whole milk price deflated by the Honolulu CPI,

DPS = retail deflated price of substitutes,

DPCPI = deflated per capita personal income,

TIME = a time trend variable (1, 2, 3, ...) to account for demographic and other changes over time,

Seasonality = Eleven monthly dummy variables reflecting the pattern of consumption during the year using December as the base,

$\sum_{i=0}^{m} AD_{t-1}$ = current and lagged deflated advertising expenditures by the industry,

$\sum_{j=0}^{m} NM_{t-j}$ = monthly negative or unfavorable media coverage of milk safety and lagged values,

$\sum_{k=0}^{p} PM_{t-k}$ = monthly positive or favorable media coverage of milk,

DUMP = pounds of contaminated milk dumped monthly,

DV = a dummy variable, zero before the March 1982 contamination, one after, and

DVTRND = a factor to account for a change in habits reflected by an (expected) shift downward in the slope of the trend. It takes values 1, 2, 3, ... after the contamination incident. DV was included to allow a shift in the intercept of the trend line.

The model was judged by several criteria. First was its consistency with economic logic including reasonable elasticities. Second was its ability to explain the variation of the dependent variable since it was used to project sales in the absence of the incident. Third was the statistical significance of the coefficients and absence of serial correlation.

From the model, projected sales were compared with estimated actual sales. The difference reflected the amount of sales lost due to consumer awareness of the contamination. However, it is known that much milk was dumped because of excessive pesticide residues. Hence, to determine the amount of sales lost over and above the loss due to product dumping, the amount of milk dumped was subtracted from the difference between projected and estimated actual sales. To determine if any mention of milk at all after the contamination announcement influenced current awareness of milk safety, the model was estimated a second time with all articles considered negative information.

CHAPTER FIVE

DATA AND FINDINGS

5.1 Data

Compared to areas under federal milk market orders, data regarding the Oahu milk shed are much more difficult to obtain. Due in part to the duopoly at the processor level, the State Division of Milk Control reports only aggregate data. Moreover, numerous lawsuits and investigations following the incident made processors and others reluctant to disclose information.

Nevertheless, adequate data were obtained to estimate fluid milk demand. A period of five years before the incident and 15 months afterward (through June 1983) was selected. Appendix One details the description of the data below. Estimation beyond 15 months was limited by the lack of access to Honolulu newspapers and the unavailability of accurate population estimates (principally the number of tourists and their average length of stay).

5.1.1 Consumption

Fluid consumption data were obtained chiefly from the Hawaii Division of Milk Control. It was assumed that before the contamination announcement, Class I utilization, the amount of milk that processors bottled, approximated quantity demanded. Because this assumption was

questionable after the contamination announcement, Class I utilization was corrected for imports and estimated route returns. Further, from September through December 1982, schools were supplied with imitation milk to avert retail shortages. To accurately reflect quantity demanded, the amount of milk that would have been sent to schools was added to the Class I utilization data for that period. Failure to correct for this underestimates the dependent variable in October and November by about 15 percent, and to a lesser extent in September and December. It was assumed that Class I utilization corrected by these factors approximated quantity demanded.

Because milk sales vary according to the day of the week, per capita consumption for each month may vary between years simply because one month may have more "high sales" days in one year and more "low sales" days in another. Hence consumption per capita per day for each month was corrected by a monthly adjustment factor (see Schlenker & Christ, 1971).

5.1.2 Population

To calculate per capita consumption, estimates of the de facto population (actual number of people on the island) were required. It is known that on a given day, tourists comprise about 10 percent of total population though this varies monthly. Hence, estimates of the monthly number of tourists on Oahu (derived from data from the Hawaii Visitors Bureau) were added to estimates of monthly resident population interpolated from annual data.

5.1.3 Prices

Retail food prices in eight Oahu supermarkets were surveyed by the Market News Branch of the Hawaii Department of Agriculture (1977-1980) and the Honolulu Advertiser (1981-present). Average retail sales were used for a one-half gallon paper container of whole milk, and a variety of possible milk substitutes including one-half gallon containers of imitation milk and fruit nectar, a 14-quart package of nonfat dry milk, 46 ounces of fruit drink, and 12 ounces of canned soda. In 1977, each was deflated by the Honolulu Consumer Price Index for urban wage earners and clerical workers. From 1978 onward, each was deflated by the Index for all urban consumers. The Bureau of Labor Statistics linked the two series so that both have the same value in December 1977.

5.1.4 Income

Per capita personal income was calculated in two steps. Quarterly state personal income was interpolated to derive monthly estimates. This was divided by monthly estimates of state resident population (similarly calculated) to estimate per capita personal income. It was assumed that Oahu and state per capita income were similar. Income was deflated by the same method as were prices.

5.1.5 Advertising

The work by Thompson and others previously cited shows generic milk promotions significantly affected milk sales in some New York markets. Hence it was suspected that milk advertising may have a similar

effect in the Oahu milk shed. No generic advertising is undertaken there, but the two processors advertise their brands. Due to the legalities ensuing after the contamination, both processors refused to disclose milk advertising expenditures. The two major newspapers also declined to reveal the amount of advertisement the companies had purchased. Two of four television stations provided gross advertising expenditures for each processor, but this included advertising for other dairy and non-dairy products. Hence, the advertising variable was not included in the estimations. Conversations with those in the advertising industry in Oahu indicated that fluid milk advertising was not heavily undertaken by either company, so this was not a major oversight. An exception might have been March and April 1983 when Meadow Gold unveiled its new milk container.

5.1.6 Media Coverage

Given that consumer awareness of the contamination may affect sales, a proxy for that awareness was necessary. As discussed previously, the mass media will affect public awareness; hence a measure of media coverage was derived. It was assumed newspaper coverage reflected total media coverage of the incident. This was supported by the national sales representative of one Oahu television station who said television coverage of the contamination was similar to that of the newspapers.

All articles related to milk and the incident were obtained from the two major Honolulu newspapers, the Honolulu Advertiser and the Honolulu Star-Bulletin. Each was coded with respect to whether they

presented positive, negative, or neutral information about milk safety. As each article was coded, confidence in the code was graded (4.0 = very sure; 0.0 = not sure at all). This gave a measure of the reliability of the coding. To determine how media coverage of the incident evolved, each article was coded not only with respect to overall milk safety, but also with respect to the components of milk safety, that is, milk quality (presence and/or danger of the contaminant in milk), the level of government protection, and the processors' concern for consumer welfare (their integrity).

Many measures of the amount of newspaper coverage exist (see Budd, Thorp, & Donohew, 1967, also Berelson, 1952). However, to best reflect the prominence of an article, the "Attention Score" developed by Budd (1964) was used which weights articles based on their placement in the paper, position on the page, size of headline, and length of article. Weights range from zero for a small article on the bottom half of page six, to five for a lengthy front-page article with a banner headline. The negative media variable was the sum of weights of those articles coded negatively in each month; similarly for the positive media variable. The content analysis, including coding criteria, and Budd's "Attention Score" are detailed in Appendix Two.

5.2 Econometric Findings

5.2.1 Determination of Appropriate Milk Substitute

First to be resolved was the choice of an appropriate substitute to include in the model. From Thompson and Eiler (1975a),

appropriate choices may be beer, coffee, or canned soda. Knowing the Hawaiian milk market, imitation milk may be more appropriate. However, a consumer survey was obtained from one of the processors showing that after the contamination announcement, more people switched to consumption of fruit juice or drinks than any other substitute. Hence, pre-contamination consumption was regressed on the deflated prices of whole milk (DPM) and fruit nectar (DPFN) and then on deflated prices of milk and fruit drink. The superior substitute in terms of sign and significance of coefficients, estimated elasticities, and ability to explain variation in consumption and absence of serial correlation was fruit nectar.[1] This compared favorably with Hogg's (1974) estimation using annual data. (As with Hogg's study, income was of unexpected sign and insignificant when included.)

---

[1]The regression was:

$$Q = \underset{(1.33)}{6.81} - \underset{(1.87)*}{4.49}\,DPM + \underset{(0.830)*}{2.26}\,DPFN + \underset{(0.145)*}{0.341}\,JA + \underset{(0.145)*}{0.322}\,FE + \underset{(0.152)}{0.221}\,MA$$

$$+ \underset{(0.151)*}{0.610}\,AP + \underset{(0.151)*}{0.516}\,MY - \underset{(0.151)}{0.244}\,JE - \underset{(0.152)}{0.250}\,JY - \underset{(0.152)}{0.169}\,AU$$

$$+ \underset{(0.155)*}{0.610}\,SE + \underset{(0.151)*}{0.373}\,OC + \underset{(0.152)}{0.219}\,NO$$

$\bar{R}^2 = 0.617$ D.W. = 1.84 price elasticity (η_p) = -0.503

Figures in parentheses are standard errors.

*Significant at the $\alpha \leq 0.05$ level.

Other substitutes were also tested but none found any better.

5.2.2 Model Estimation

Estimation of the model yielded the following results:

$$
\begin{aligned}
(1a)\quad Q = {} & 10.2 - 4.69\,DPM + 0.926\,DPFN - 0.000500\,OPCPI \\
& (4.09)^{**}\ (2.16)^{**}\quad (0.836)\qquad (0.000709) \\
& - 0.00663\,TIME + 0.233\,JA + 0.222\,FE + 0.0955\,MA + 0.451\,AP \\
& (0.00199)^{***}\quad (0.131)^{*}\quad (0.130)^{*}\quad (0.131)\qquad (0.141)^{***} \\
& + 0.413\,MY - 0.379\,JE - 0.367\,JY - 0.234\,AU + 0.515\,SE \\
& (0.140)^{***}\ (0.136)^{***}\ (0.137)^{***}\ (0.137)^{*}\quad (0.139)^{***} \\
& + 0.368\,OC + 0.161\,NO - 0.149\,DV - 0.0240\,DVTRND \\
& (0.133)^{***}\ (0.131)\quad (0.365)\quad (0.0276) \\
& - 3.15 \times 10^{-7}\,DUMP - 0.00301\,NM - 0.0271\,PM \\
& (7.34 \times 10^{-8})^{***}\quad (0.00292)\qquad (0.00892)^{***}
\end{aligned}
$$

$\bar{R}^2 = 0.938$ $\qquad \eta_p = -0.572$

D.W. = 2.14 $\qquad \eta_y = -0.417$

Standard error of regression = 0.224 oz./person/day
Mean of dependent variable = 5.14 oz./person/day

Figures in parentheses are standard errors.

*Significant at the $\alpha \leq 0.10$ level.

**Significant at the $\alpha \leq 0.05$ level.

***Significant at the $\alpha \leq 0.01$ level.

The estimation contained several unexpected results. A negative though insignificant relationship between deflated per capita personal income (DPCPI) and consumption was indicated. This may have resulted from income being correlated with another factor which negatively influenced consumption. The negative coefficient of the positive media variable (PM) may be due to its high correlation with negative media (NM). (The coefficient of correlation was 0.767.) A

positive coefficient of the dummy variable was expected if the downward trend in consumption steepened. Its negative coefficient indicates that the trend not only steepened but still shifted downward. Confidence in the coefficients of both DV and DVTRND is low though. Income elasticity is unusual, but insignificant. Price elasticity is high, but not unreasonable compared to elasticity estimates shown in Table 5.1. Because retail milk prices in Honolulu are the nation's highest, one would not be surprised if the price elasticity were higher.

Table 5.1.--Estimated elasticities of retail fluid milk demand.

Source	Period	Location	Own-Price	Income
George and King (in Tomek, 1981)	1946-67	U.S.	-0.35	0.20
Renaud (1971)	1950-67	Hawaii	...	0.27
Prato (in Cook et al., 1978)	?	Florida	-0.58	...
Boehm (1976)	1966-75	Average across U.S. cities	-0.12 to -0.30	0.07 to 0.14
Thompson and Eiler (1975b)	1971-74	New York City	-0.19	0.29
Kinnucan (1983)	1978-81	Buffalo, New York	-0.66 to -0.73	0.23 to 0.39

The positive media variable was dropped due to its unexpected sign and correlation with negative media. The new estimation is shown below:

$$
\begin{aligned}
(1b)\quad Q = {} & 10.3 - 4.39\,DPM + 0.826\,DPFN - 0.000539\,DPCPI \\
& (4.37)^{**} \quad (2.31)^{*} \quad (0.893) \quad (0.000758) \\
& - 0.00688\,TIME + 0.249\,JA + 0.218\,FE + 0.0670\,MA + 0.422\,AP \\
& (0.00213)^{***} \quad (0.140)^{*} \quad (0.140) \quad (0.140) \quad (0.151)^{***} \\
& + 0.350\,MY - 0.353\,JE - 0.367\,JY - 0.183\,AU + 0.430\,SE \\
& (0.148)^{**} \quad (0.145)^{**} \quad (0.147)^{**} \quad (0.145) \quad (0.146)^{***} \\
& + 0.359\,OC + 0.191\,NO + 0.142\,DV - 0.0449\,DVTRND \\
& (0.142)^{***} \quad (0.139) \quad (0.377) \quad (0.0285) \\
& - 4.60 \times 10^{-7}\,DUMP - 0.00888\,NM \\
& (5.93 \times 10^{-8})^{***} \quad (0.00233)^{***}
\end{aligned}
$$

$\bar{R}^2 = 0.929$ $\quad \eta_p = -0.535$

D.W. = 2.19 $\quad \eta_y = -0.449$

Standard error of regression = 0.239 oz./person/day
Mean of dependent variable = 5.14 oz./person/day

*Significant at the $\alpha \leq 0.10$ level.

**Significant at the $\alpha \leq 0.05$ level.

***Significant at the $\alpha \leq 0.01$ level.

The sign of income's coefficient was again unexpected but still insignificant. Because income was expected to be positively related to consumption, a conditional regression was estimated fixing income elasticity at that found by Renaud (1971).[2] (See Table 5.1.) The

---

[2]Other options were explored including the omission of DV and DVTRND. However, DVTRND is "statistically suggestive" and when both were dropped, the sign of income's coefficient became positive as did that of DPM (though both were insignificant). Simply dropping income from the regression yielded coefficients that were insignificantly different from those generated by the conditional regression.

quantity CQ = Q - [0.267 x ($\overline{Q}/\overline{DPCPI}$) x DPCPI] was used as the dependent variable.

Further, the lag on the negative media variable was also explored. An ad-hoc method was used, successively lagging NM until its coefficient became insignificant or until the sign changed (Gujarati, 1978). A usual problem with this approach is that multicollinearity may distort the t-statistics. In the case of NM, multicollinearity was doubtful since values changed from a series of zeros to very high values (122) as the recalls were announced. These values then declined but with much fluctuation. It is recognized that geometric and polynomial distributed lags are commonly used as well (e.g., Yon & Mount, 1975; Butler & Thompson, 1979).

The model selected involved a one-month lag. (The two-month lag had a positive coefficient.) Results follow.

(1c) $Q = 5.68 - 3.07\ DPM + 0.663\ DPFN - 0.00582\ TIME + 0.309\ JA$
$(1.25)^{***}\ (1.78)^{*}\ (0.845)\ (0.0196)^{***}\ (0.133)^{**}$

$+ 0.275\ FE + 0.117\ MA + 0.514\ AP + 0.457\ MY - 0.300\ JE$
$(0.132)^{**}\ (0.135)\ (0.137)^{***}\ (0.137)^{***}\ (0.136)^{**}$

$- 0.319\ JY - 0.125\ AU + 0.528\ SE + 0.400\ OC + 0.207\ NO$
$(0.139)^{***}\ (0.141)\ (0.150)^{***}\ (0.138)^{***}\ (0.137)$

$+ 0.0305\ DV - 0.0303\ DVTRND - 3.70 \times 10^{-7}\ DUMP$
$(0.384)\ (0.0298)\ (8.29 \times 10^{-8})^{***}$

$- 0.0103\ NM - 0.00463\ NM(-1) + 0.000311\ DPCPI$
$(0.00229)^{***}\ (0.00282)$

$\bar{R}^2 = 0.929$ $\eta_p = -0.511$
D.W. = 2.03 $\eta_y = 0.268$ (from Renaud, 1971)

Standard error of regression = 0.236
Mean of the dependent variable = 3.77

*Significant at the $\alpha \leq 0.10$ level.

**Significant at the $\alpha \leq 0.05$ level.

***Significant at the $\alpha \leq 0.01$ level.

Signs were all as expected and the Durbin-Watson statistic indicated a low probability of serial correlation. The coefficient of lagged NM and DVTRND were insignificant but "statistically suggestive." The model explained more than 90 percent of the variation of the dependent variable; actual and estimated per capita consumption are shown in Figure 5.1.

The direct and carryover effect of negative media coverage is the sum of the coefficients of current and lagged negative media, or

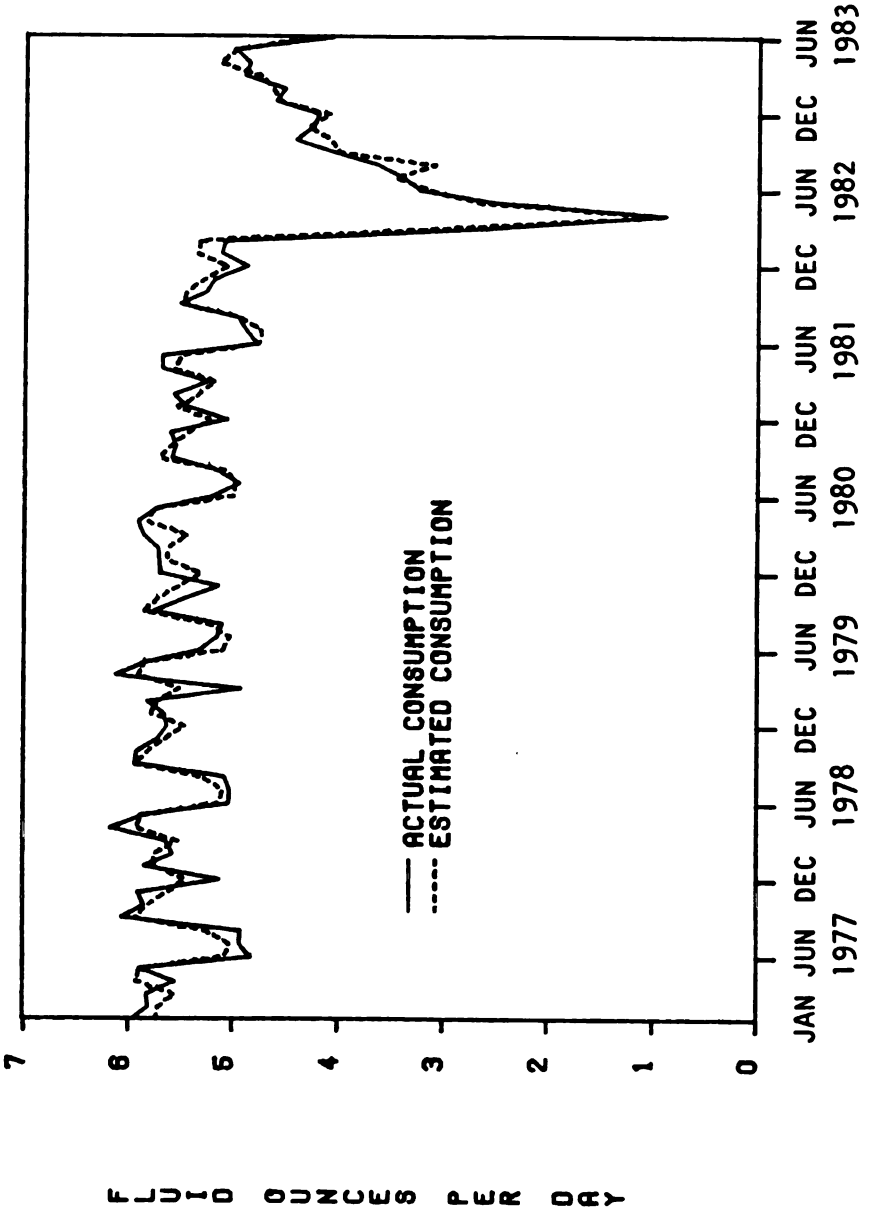


Figure 5.1.--Per capita consumption: Actual and estimated, January 1977-June 1983.

-0.0149. Evaluated at the mean of the variables, a negative media elasticity of -0.0219 was calculated.[3] This indicates that a 1 percent increase in negative media coverage reduces consumption about 0.02 percent.

It is interesting to note that Thompson, Eiler, and Forker (1976) estimated the direct and carryover elasticity of generic milk advertising in New York City to be 0.0212. Kinnucan (1983) estimated long-run milk advertising elasticity to be about 0.12 in the Buffalo, New York, market. (This is an average elasticity from five functional forms Kinnucan used to estimate fluid milk demand.)

5.3 Estimates of Lost Sales

5.3.1 Quantity Estimates of Lost Sales

With Equation 1c, monthly sales in the absence of the incident were projected and compared to estimated actual sales. This reflects sales lost due to consumer awareness of the contamination considering changes in deflated milk and fruit nectar prices, income, and seasonality. Projected and estimated actual sales are shown in Figure 5.2. In the aggregate, from March 1982 through June 1983, the difference between projected sales in the absence of the contamination and estimated actual sales was about 39 million pounds of milk. To determine the quantity of sales lost beyond the amount dumped, monthly estimates of total sales loss were corrected for the amount dumped each month.

---

[3]Calculations were:

$$\frac{dCQ}{dNM} \times \frac{\overline{NM}}{\overline{CQ}} \quad \text{or} \quad -0.0149 \times \frac{5.55}{3.77} = -0.0219$$

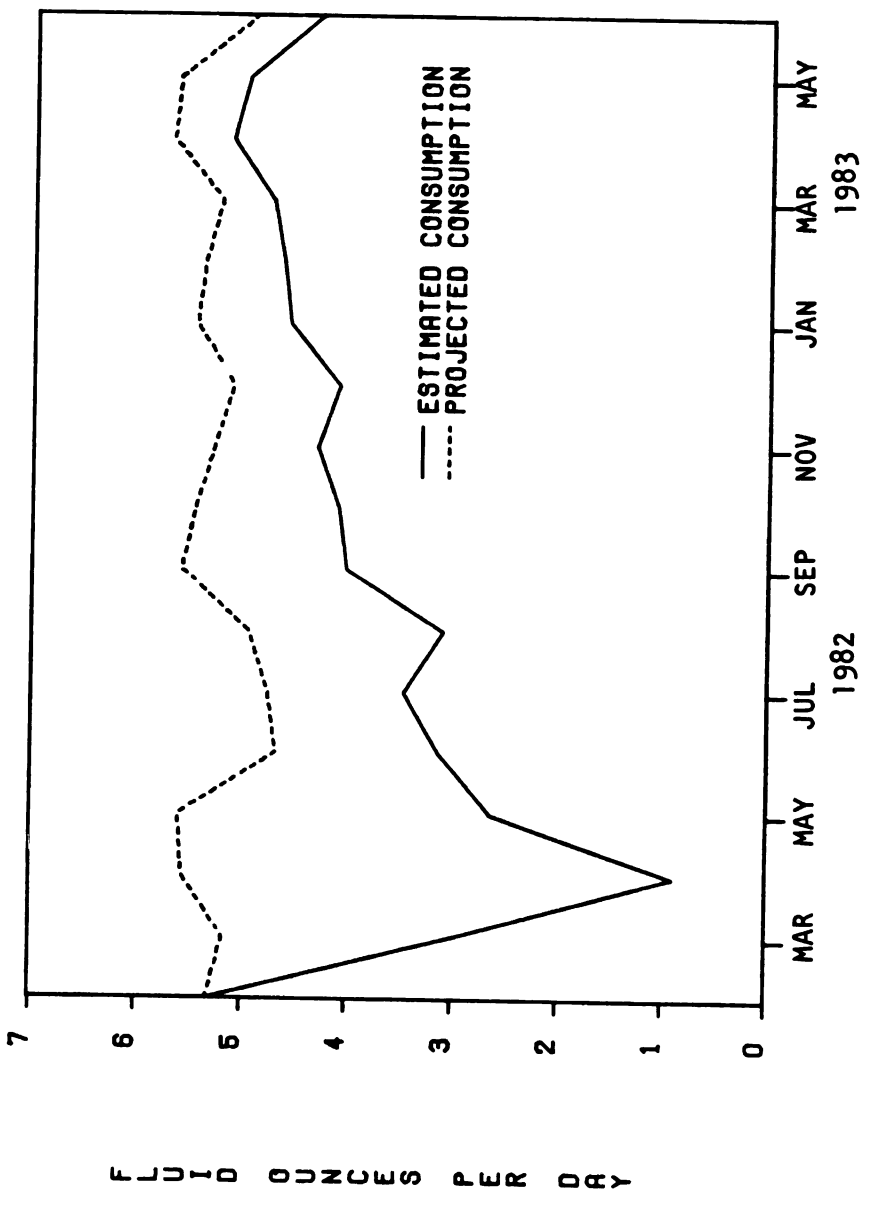


Figure 5.2.--Per capita consumption: Projected and estimated, February 1982-June 1983.

For example, the difference between projected and estimated March 1982 consumption was 3,617,860 pounds of milk. However, 3,155,170 pounds were dumped. The difference was a loss of 462,690 pounds of milk that was available but not used for Class I purposes. By inspection of the utilization data (Figure 2.1), any uncontaminated milk not used as Class I from March 1982 through February 1983 could have been used as Class I if there were normal demand for it. Hence, the true sales loss can be accurately determined over this period.[3] This is compared with estimated losses in Table 5.2. (Zeros indicate months when milk dumped was greater than estimates losses.)

The model underestimated known sales, but did generally follow the trend in sales loss. It correctly identified periods of no sales loss in May, October, and November because all available milk was used for Class I utilization. Losses were underestimated in late spring-early summer 1982, however. It was estimated that about 6.5 million pounds of milk that would have been used as fresh fluid consumption were not, due to awareness of the contamination. Using actual losses from March 1982 through February 1983 instead of estimates, this figure was about 8.4 million pounds.

---

[3]Beyond February, some of the milk not used as Class I may have been used in other uses even had the incident never occurred. This milk cannot be considered a cost from the contamination. Beginning in March 1983, it appears that demand approached pre-contamination levels. To determine how closely it did requires a more discriminating technique than just inspection. Hence the econometric model was developed.

Table 5.2.--Comparison of known and estimated sales loss (pounds).

		Known Loss	Estimated Loss
1982	MAR	1,396,888	462,690
	APR	298,429	0
	MAY	0	0
	JUN	270,791	0
	JUL	598,988	0
	AUG	597,589	992,735
	SEP	26,907	535,495
	OCT	0	0
	NOV	0	0
	DEC	505,146	231,486
1983	JAN	264,726	325,027
	FEB	877,757	346,342
February Subtotal		4,837,221	2,893,775
	MAR	?	593,279
	APR	?	851,822
	MAY	?	1,073,750
	JUN	?	1,064,680
	Total		6,477,306

5.3.2 Estimation of the Value of Lost Sales

Assigning value to uncontaminated milk involves a complex system of classified pricing. Assigning value to the milk sales lost is likewise complex.[4] If the milk had no other use, the loss because consumers did not purchase it would be the full $21.09 per hundredweight

[4]Estimation of the effect of the incident on the average, or blend price producers receive for their milk was not possible. Actual monthly blend prices are available, but computation of projected prices in the absence of the incident requires access to confidential information the Division of Milk Control would not release.

producers could have received for Class I milk. However, at a minimum, producers received $2.92 per hundredweight for milk that had been salvaged. Alternatively, milk not used as Class I could have been used as Class II (producer price: about $13.50 per hundredweight) or for Class I-A or export (worth $18.77 per hundredweight). Hence, the loss to Oahu producers through June 1983 could have ranged from about $195,000 to $1,530,000 assuming, respectively, all the milk was used as Class I-A or salvaged.

More precise estimates were calculated. Actual sales loss from March 1982 through February 1983 was determined by multiplying the amount of milk used in each non-Class I use by the difference between the Class I and each alternative use price. Beyond February, the estimated loss was calculated to determine how much milk not used as Class I would have been in the absence of the contamination. The amount of milk salvaged up to this limit of the sales loss was multiplied by the monthly Class I-salvage price differential. If less milk were salvaged than sales lost, then the amount of Class II milk was added up to the limit of the sales loss and multiplied by the Class I-Class II differential.

For example, given the June sales loss was 1,064,680 pounds, then all 1,004,506 pounds of milk salvaged was valued at the Class I-salvage price differential for a value of $180,510. An additional 60,174 pounds (1,064,680 - 1,004,506) from Class II use would also have gone to fluid consumption if the incident never occurred. Thus, an additional $4,591 was lost (60,174 pounds x Class I-Class II price

differential [$0.0763]). Monthly sales losses are shown in Table 5.3. Total sales loss due to consumer awareness of the incident from March 1982 through June 1983 was about $626,000.

5.4 Media Findings

5.4.1 Effect of All Media on Sales

To determine if any mention of milk adversely affected sales (e.g., by reminding the public of the current or past problem), total media coverage (TM) of milk, the contamination incident, and Safeway's bid to enter the market replaced negative media coverage in the conditional regression, Equation 1c. The results were:

$$
\begin{aligned}
(1d)\quad Q = {} & 6.41 - 3.77\,DPM + 0.155\,DPFN - 0.00618\,TIME + 0.308\,JA \\
& (1.20)^{***}\ (1.70)^{**}\ \ (0.787)\ \ \ (0.00184)^{***}\ \ (0.125)^{**} \\
& + 0.283\,FE + 0.183\,MA + 0.534\,AP + 0.539\,MY - 0.273\,JE \\
& (0.124)^{**}\ \ (0.128)\ \ \ (0.129)^{***}\ (0.132)^{***}\ (0.131)^{**} \\
& - 0.303\,JY - 0.154\,AU + 0.514\,SE + 0.402\,OC + 0.203\,NO \\
& (0.130)^{**}\ \ (0.132)\ \ \ (0.138)^{***}\ (0.130)^{***}\ (0.129) \\
& - 0.294\,DV + 0.0102\,DVTRND - 2.95 \times 10^{-7}\,DUMP \\
& (0.399)\ \ \ (0.0326)\ \ \ \ \ \ \ (9.31 \times 10^{-8})^{***} \\
& - 0.00665\,TM - 0.00268\,TM(-1) + 0.000311\,DPCPI \\
& (0.00121)^{***}\ (0.00171)
\end{aligned}
$$

$\bar{R}^2 = 0.937$ $\qquad \eta_p = -0.627$

D.W. = 2.22 $\qquad \eta_y = 0.268$ (from Renaud, 1971)

Standard error of regression = 0.222
Mean of the dependent variable = 3.77

*Significant at the $\alpha \leq 0.10$ level.

**Significant at the $\alpha \leq 0.05$ level.

***Significant at the $\alpha \leq 0.01$ level.

Table 5.3.--Monthly sales losses.

Alternative Use of Milk	Quantity (Pounds)	Alternative Use Price ($/lb.)	Price Differential ($/lb.)	Value of Lost Sales	
March 1982					
Salvaged	1,182,624	0.1476	0.0633	74,860	
Class II	213,557	0.0792	0.1317	28,125	
Class I-A	707	0.1877	0.0232	16	
Sales loss	1,396,888				$103,001
April					
Class I-A	298,429	0.1877	0.0232	6,924	
Sales loss	298,429				$ 6,924
May					
Sales loss	0			0	0
June					
Salvaged	33,772	0.0292	0.1877	6,136	
Class I-A	237,019	0.1877	0.0232	5,499	
Sales loss	270,791				$ 11,635
July					
Salvaged	170,237	0.0293	0.1816	30,915	
Export	2,546	0.1877	0.0232	59	
Class I-A	426,205	0.1877	0.0232	9,888	
Sales loss	598,988				$ 40,862
August					
Class II	178,956	0.1358	0.0751	13,440	
Class I-A	418,633	0.1877	0.0232	9,712	
Sales loss	597,589				$ 23,152

Table 5.3.--Continued.

Alternative Use of Milk		Quantity (Pounds)	Alternative Use Price ($/lb.)	Price Differential ($/lb.)	Value of Lost Sales	
September						
Class I-A		26,907	0.1877	0.0232	624	
	Sales loss	26,907				$ 624
October	Sales loss	0			0	0
November	Sales loss	0			0	0
December						
Salvaged		184,556	0.0311	0.1798	33,183	
Class I-A		320,590	0.1877	0.0232	7,438	
	Sales loss	505,146				$ 40,621
January 1983						
Class I-A		264,726	0.1877	0.0232	6,142	
	Sales loss	264,726				$ 6,142
February						
Class II		137,133	0.1349	0.0760	10,422	
Export		123,647	0.1877	0.0232	2,869	
Class I-A		616,977	0.1877	0.0232	14,313	
	Sales loss	877,757				$ 27,604

Table 5.3.--Continued.

Alternative Use of Milk	Quantity (Pounds)	Alternative Use Price ($/lb.)	Price Differential ($/lb.)	Value of Lost Sales	
March					
Salvaged	30,631	0.0411	0.1698	5,201	
Class II	99,526	0.1351	0.0758	7,544	
Export	52,271	0.1877	0.0232	1,213	
Class I-A	410,851	0.1877	0.0232	9,532	
Estimated sales loss	593,279				$ 23,490
April					
Salvaged	143,172	0.0412	0.1697	24,296	
Class II	610,533	0.1351	0.0758	46,278	
Export	27,632	0.1877	0.0232	641	
Class I-A	70,485	0.1877	0.0232	1,635	
Estimated sales loss	851,822				$ 72,850
May					
Salvaged	202,530	0.0446	0.1663	33,681	
Class II	564,195	0.1346	0.0763	43,048	
Export	47,825	0.1877	0.0232	1,110	
Class I-A	259,200	0.1877	0.0232	6,013	
Estimated sales loss	1,073,750				$ 83,852
June					
Salvaged	1,004,506	0.0312	0.1797	180,510	
Class II	60,174	0.1346	0.0763	4,591	
Estimated sales loss	1,064,680				$185,101
Estimated total value of lost sales	8,420,752				$625,858

Price elasticity is high but still acceptable. The coefficient of TM lagged one month was negative and "statistically suggestive." The coefficient of DV became negative while that of DVTRND became positive though both were very insignificant. The direct and carryover effect on consumption of all media coverage related to the incident, whether negative, positive, or neutral, was -0.00933. Evaluated at the mean, this yielded a total media elasticity of -0.0351, indicating a 1 percent rise in any media attention given to the milk issue reduced consumption about 0.04 percent. Based upon the comparative elasticities between negative media (-0.0219) and total media (-0.0351) it was suggested that any publicity of milk at all reduced consumption more than just bad publicity, although a statistical test implied no significant difference between them.[5]

---

[5]Since the variances of the regressions 1c and 1d were insignificantly different, the elasticities were statistically compared. A major assumption was that the respective ratios of mean negative and total media to the mean of the dependent variable were known with no variance. Adapted from Kmenta (1981, p. 372), the test statistic used was:

$$\frac{A - B}{s_{A-B}} \sim t_{N-K}$$

where

$$A = (\Sigma\ \hat{\beta}_{NM} \times \overline{NM/CQ})$$

$$B = (\Sigma\ \hat{\beta}_{TM} \times \overline{TM/CQ})$$

and $$s_{A-B} = [(\overline{NM/CQ})^2\ \mathrm{Var}(\Sigma\ \hat{\beta}_{NM}) + (\overline{TM/CQ})^2\ \mathrm{Var}(\Sigma\ \hat{\beta}_{TM}) - 2\ (\overline{NM/CQ})\ (\overline{TM/CQ})\ \mathrm{Cov}(\Sigma\ \hat{\beta}_{NM}, \Sigma\ \hat{\beta}_{TM})]^{\frac{1}{2}}$$

It was assumed that the covariance was zero although relaxing this would increase the t-statistic. The assumption that $\overline{NM/CQ}$ and $\overline{TM/CQ}$ are known with no variance is more problematic.

However, because the signs of the DV and DVTRND coefficients changed with the incorporation of a one-month lag on TM, negative and total media elasticities were calculated from models in which neither variable was lagged. Dropping lagged NM did not substantially change Equation 1c. Dropping lagged TM yielded expected signs in the coefficients of DV and DVTRND. The total media elasticity (-0.0241) was found to be significantly different from that of negative media (-0.0140) at the $\alpha \leq 0.10$ level.

5.4.2 Trends in Media Coverage

Surprisingly, the pattern of media coverage was not as expected. Rather than negative media (NM) peaking and slowly falling as positive media (PM) rose, NM fluctuated over the contamination period (Figure 5.3). After the initial media attention subsided, new facts emerged which renewed concern and confusion over milk safety. After this second peak, a second, lesser contamination incident occurred in December (antibiotics in milk). This passed as the Safeway controversy emerged. Throughout the period, media sensitivity to any contamination was heightened. Discovery of heptachlor in wild game was reported, as were traces of DDT in the island milk supply (which, health department officials explained, was not without precedent). Positive media coverage did not rise slowly as expected, but instead followed the pattern of NM. After the heptachlor contamination announcement, government officials rushed to reassure the public of the safety of milk. After subsequent negative information about milk safety, government officials

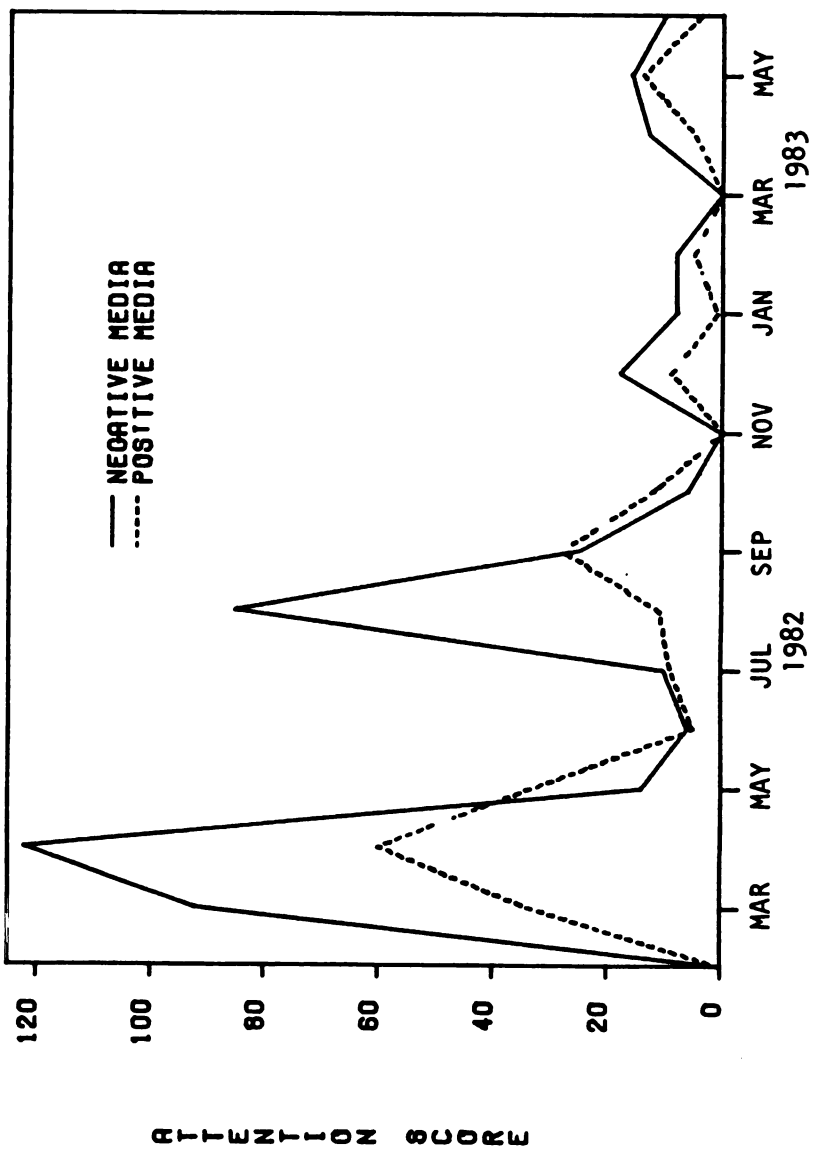


Figure 5.3.--Negative and positive media coverage, February 1982-June 1983.

would again counteract it. Hence as negative media coverage fluctuated, so did that of positive media. Little attention was given the May 1983 announcement that all dairy herds were virtually cleared of heptachlor.

The components of milk safety (milk quality, level of government protection from milk contamination, and processor integrity) were also examined. The measure of processor integrity revealed little since both processors were rarely criticized. It was conservatively assumed that negative information about one processor would only cause consumers to switch milk brands, so only when both processors were criticized did this measure assume non-zero values. Dairymen were rarely criticized for producing a contaminated product. Negative coverage of milk quality was generally greater than negative coverage of the level of government protection (Figure 5.4). Certainly government investigations kept the matter alive in the press, but they were not the only factor. New facts about duration of exposure, a second contamination incident, and efforts by Safeway to import milk from California reminded the public of health risks associated with Oahu milk.

5.5 Demographic Findings

Surveys conducted after the initial contamination announcement reveal how different segments of the population reacted to it. One survey was conducted for Foremost three weeks after the first recall, but before the last two (Table 5.4). More than 99.5 percent of those randomly sampled were aware of the contamination. A small majority of

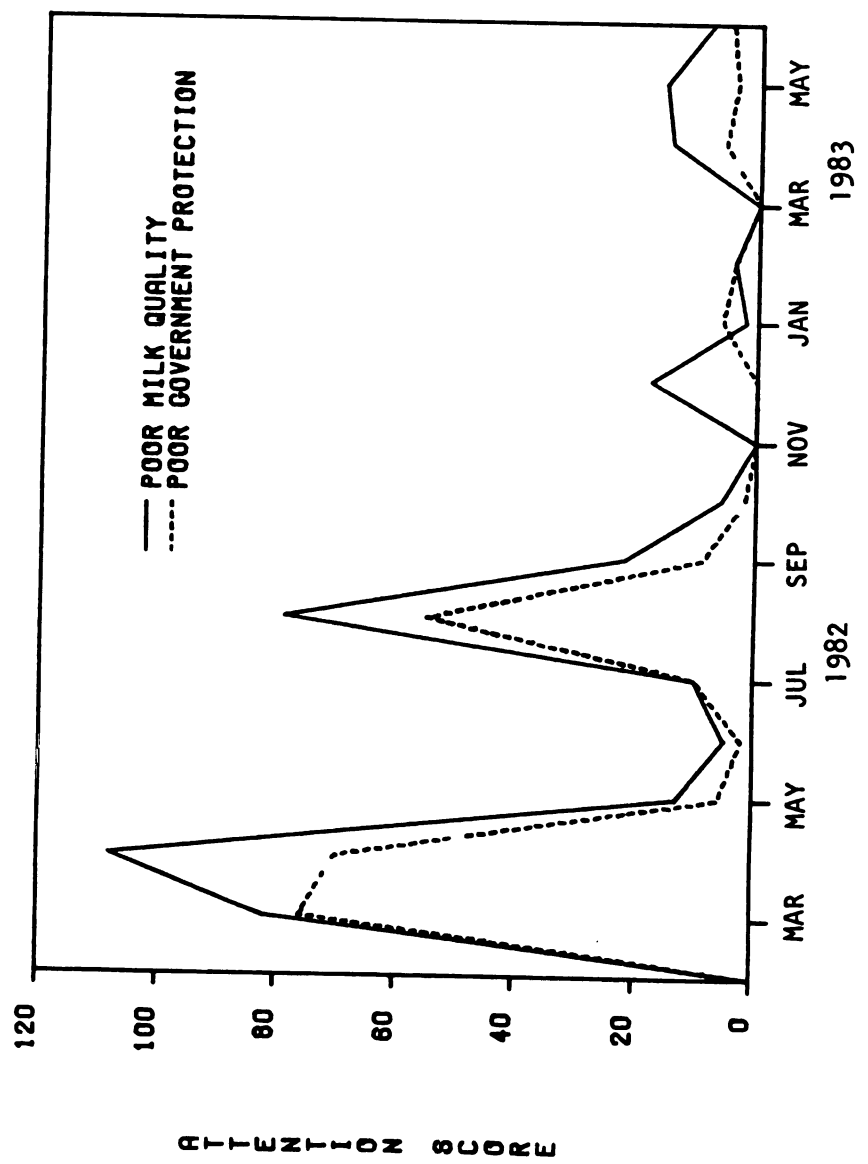


Figure 5.4.--Components of negative media coverage, February 1982-June 1983.

Table 5.4.--Effect of publicity on milk purchasing.

	Total	Children in Household			Age				Ethnicity			Sex	
		None	1-2	3+	Under 25	25-34	35-49	50+	Caucasian	Oriental	Other	Male	Female
	%	%	%	%	%	%	%	%	%	%	%	%	%
Buy milk now...													
more	-	-	-	-	-	-	-	-	-	-	-	-	-
less	56	47	59	68	62	51	58	57	47	60	63	48	58
same	44	53	41	30	38	48	42	43	53	39	37	52	41
Haven't heard publicity	*	-	-	2	-	1	-	-	-	1	-	-	-
don't know	-	-	-	-	-	-	-	-	-	-	-	-	*
Base: (total sample)	(352)	(142)	(157)	(53)	(48)	(98)	(107)	(93)	(133)	(101)	(112)	(92)	(260)

Source: Foremost Dairies, Inc.

*Less than one-half of 1 percent.

households without children did not alter their milk purchases, but a larger share of households with children did. Across age groups, more of the youngest shoppers reduced consumption than other groups. Unlike the Schuker et al. (1983) saccharin study, the oldest age group did alter milk consumption. It is unknown why a lesser percentage of those in the 25-34-year-old group changed consumption than others. Perhaps they represent childless individuals who consume little milk. Non-Caucasians in Hawaii consume less milk than Caucasians, and Scott (1967) found that non-Caucasians drink milk more for its nutritional value than for its taste. Hence one would expect more non-Caucasians to reduce consumption than Caucasians. Indeed, Table 5.4 shows the change in consumption more among Orientals and others (about 70 percent of the population) than among Caucasians. Finally, the shift was greater among females than males. This may understate a later shift in purchases since the telephone survey began the day after the presence of heptachlor in breast milk was revealed.

The same survey also asked if normal whole milk purchasing would be resumed after the incident (Table 5.5). Again, a greater percentage of males and those without children indicated they would resume normal purchases than females and those with children. Interestingly, a higher percentage of those in the oldest age group responded affirmatively than among other ages. This suggests the older age group is more likely to return to pre-contamination habits (i.e., habits established over their lifetime are less easily broken than those of younger people). Also, a larger percentage of Orientals, who consume milk more

Table 5.5.--Whether whole milk purchases would return to normal.

	Total	Children in Household			Age				Ethnicity			Sex	
		None	1-2	3+	Under 25	25-34	35-49	50+	Cauca-sian	Ori-ental	Other	Male	Female
	%	%	%	%	%	%	%	%	%	%	%	%	%
If milk problems were solved, would you go back to buying as much whole milk?													
yes	71	83	63	70	61	78	62	81	66	83	67	75	69
no, buy a little less	8	6	9	8	11	11	8	3	4	2	16	-	11
no, buy a lot less	16	6	22	14	25	9	21	8	24	12	11	18	15
don't know	6	4	5	8	4	2	8	8	6	2	6	8	5
Base: (persons who now buy less whole milk)	(160)	(47)	(76)	(37)	(28)	(46)	(47)	(37)	(53)	(41)	(64)	(40)	(120)

Source: Foremost Dairies, Inc.

for reasons of nutrition, would resume pre-contamination purchases than Caucasians. A greater proportion of Caucasians than Orientals changing purchases over the long-term may reflect a greater change in milk consumption habits among Caucasians than Orientals. Perhaps the former group perceived the incident as indicative of long-term problems with contaminated milk supplies and poor protection of public health by the government. Orientals may have perceived the incident with less concern.

If some believed the government was responsible for poor protection of public health, this may be reflected in political opinions. Democratic Governor George Ariyoshi was re-elected nine months after the initial recall. Although voting reflects opinions on a variety of issues, the state's mishandling of the heptachlor contamination was apparently insufficient reason to remove the incumbent; Republican Governor William Milliken of Michigan was also re-elected after the PBB incident. Indeed, three months before the elections a political opinion poll was conducted for the Honolulu Advertiser in which questions about milk consumption were also asked. Thirty-one percent of those polled said the incident was "just one of those things that happen these days," and 30 percent blamed the health department for the crisis (in Keir, 8/27/82). On average across all political parties, only 3 percent blamed the Governor, although 6 percent of the Independents blamed him. Further, the survey showed more Independents than Democrats or Republicans were still buying less milk than before the recalls. This is not surprising since the Independent candidate

attempted to make heptachlor contamination a key election issue. This implies that a spokesman who is believed to be more credible than those in government may influence consumer attitudes.

CHAPTER SIX

SUMMARY AND IMPLICATIONS

This research was undertaken with several objectives in mind. One was to develop a methodology to estimate producers' sales loss due to consumer awareness of food contamination. Second, the methodology was applied to determine costs to Oahu dairymen following heptachlor contamination of their herds. From this estimation and study of the characteristics of the incident, policy implications were drawn.

6.1 Methodology

The demand model considering the impact of media coverage of the incident, scope of the contamination, and a possible change in milk consumption habits is less restricted than other models which examine consumer response to food contamination. Following the approach of Schulstad and Stoevener (1978) and Swartz and Strand (1981), another model was estimated incorporating a negative media variable but excluding factors accounting for the scope of the contamination and possible changes in habits. Compared to known losses from March 1982 through February 1983, this model substantially underestimated monthly sales loss in all but two months in which sales loss was greatly overestimated. Consideration only of negative media coverage restricts

the model and hampers accurate estimation of sales loss following a massive contamination incident.

The pervasiveness of the contamination is a factor that apparently also affected sales since some consumers may have refrained from consumption until the problem subsided. It was also suspected that repeatedly disposing of one's milk and dairy products or returning them for refunds may have changed consumption habits. The complete model (Equation 1c) accounted for these factors and yielded better estimates of sales loss. Variables accounting for a change in habits were statistically insignificant but one was "suggestive."

This complete model is most appropriate for study of massive contamination incidents but is also applicable for smaller occurrences. In these instances, the dumping variable, the dummy variable, and the DVTRND variable may drop out of the model if little product is dumped and if habits do not substantially change. One is then left with a model similar to those of Schulstad and Stoevener and Swartz and Strand.

The model developed is not without weaknesses. Although it followed the trend in monthly lost sales better than the restricted model, known losses through February 1983 were still underestimated, so estimated losses calculated through June 1983 may also be an underestimate. A key assumption of this method is that consumer awareness of the contamination and not the contamination itself leads to sales loss. Awareness of such problems (e.g., antibiotic residues in beef products) may depend on the different attention given by different media, and

reaction may be influenced by other factors. The Oahu incident was very intense, and the assumption of similar newspaper and other media coverage was reasonable. For other incidents, this assumption may be inappropriate, especially if people gain awareness through one medium which gives the issue different prominence than others. Further, the Oahu incident involved a more immediate threat stemming from the milk in one's refrigerator. Other contamination scares, such as high EDB residues in some bakery goods, are less direct and hence less attention may be paid them. The studies cited above share these weaknesses however.

This methodology is useful to several groups involved in contamination incidents. At least in this occurrence, government officials declined to impose fines on Meadow Gold for marketing contaminated milk in December 1982 because they felt the company had suffered enough in terms of lost sales. This methodology enables officials to weigh such choices by determining sales loss to violators of food safety regulations. Producers of the contaminated product will wish to quantify their sales losses when they present the economic impact of the incident to government agencies which may provide financial aid. Producers whose feed is contaminated by the supplier, or competent, ethical producers of a quality product who suffer because their fellow producers market an adulterated product may use this methodology in lawsuits to recoup the cost of lost sales from those responsible.

6.2 Estimate of Losses

The magnitude of fresh fluid milk sales loss due to consumer awareness of milk contamination may be approached from several perspectives. It is important to note that these losses are only a portion of total producer costs which include product and feed dumped, laboratory testing, veterinarian and legal fees, higher interest and labor costs, and in cases such as PBB, animal mortality and extra holding costs. (These losses in turn are only part of the total costs to retailers, consumers, and government agencies who are affected by a contamination incident.) It is known that Oahu dairymen received $8,551,515 from the federal Dairy Indemnification Program for milk dumped (USDA, DIP, 1983 & 1984). Thus the $626,000 sales loss due to consumer awareness is an additional 7 percent of the dumping loss. Clearly, dumping was the greater cost, but once the contamination became known, dumping was inevitable; losses due to consumer awareness could have been minimized by more effective government and industry response to the incident. Further, since dairymen were paid for their dumped milk, the sales loss became a greater share of their total cost from the incident. By comparing sales loss to actual marketings over the period, it is seen that marketings could have been 3 percent higher than they actually were. As noted earlier, Swartz and Strand (1981) estimated that losses to consumers and producers due to consumer awareness of kepone contamination of oysters were 5 percent of actual marketings. Since the study period ended before sales had returned to pre-contamination levels, total sales loss to Oahu dairymen is surely greater than estimated here.

It is worthwhile to compare estimated sales loss to fines that could have been levied for producing a contaminated product. Before the incident, the maximum fine for violating Hawaiian milk safety regulations was $500 per violation. In response to the incident, the maximum fine for violators of State food safety regulations was increased to $10,000. If all 16 Oahu dairy operations were fined, penalties would still be only about 25 percent of the sales loss. Hence, fear of lost sales in this instance would far outweigh fear of being fined for marketing contaminated milk.

Although $626,000 is minor compared to the amount of milk dumped, this was about $39,000 per producer or about $2,400 per producer per month. Hence the cost in terms of lost sales was still substantial to each producer. This cost also reflects the amount a producer would be willing to pay to avoid such a cost. If milk testing for heptachlor in cows' milk cost the same as testing in mothers' milk ($150 per sample), each producer could have spent $2,250 per month to have milk tested every other day to avoid a loss from lost sales.

6.3 Characteristics of Massive Food Contamination Incidents

Government officials, producers of the contaminated product whether directly affected or not, producers of substitutes and complements, and consumers all benefit by knowing what to expect from these incidents. From Michigan's PBB incident and heptachlor contamination of Oahu milk, characteristics of these incidents become evident. First, costly decisions by industry and government officials are made

in an environment of great uncertainty. Without prior studies, scientists cannot give definite counsel to decision-makers who attempt to balance protection of public health with avoiding costs to the industry involved. Second, the fear of lost sales to the company or industry paralyzes decision-makers precisely at the time swift action is needed. Hesitancy to act was seen in both the PBB and heptachlor cases where violative samples were not acted upon because they were "unofficial."

Consumers also operate in an environment of uncertainty. In both incidents, scientists presented contradictory opinions and evidence about the health effects of the contaminant. Government officials rushed to reassure the public that the problem was isolated, that health risks were minimal, and that the situation was under control. Subsequent events belied these assurances. In both instances the media shared responsibility for consumer confusion with headlines such as "Bad Milk Called Harmless" (Honolulu Star-Bulletin, 3/20/82) and "Tainted Food Is Safe, FDA Reports" (in Chen, 1979).

As seen from media coverage of both incidents, publicity does not quickly diminish. After the initial peak of publicity, new aspects of the contamination are revealed and media coverage rises. This may be due to scientific studies about the effect of the contaminant or information about the length of exposure. Government investigations keep the matter alive, but heightened media attention about contamination of any kind, fueled by other contamination problems, protracts consumer awareness as well.

6.4 Policy Implications

From a brief comparison with the 1982 Tylenol incident, policy implications may be drawn for industry and government officials. Seven people died after using cyanide-laced Extra-Strength Tylenol, a pain reliever. Johnson and Johnson, the parent company of Tylenol's manufacturer, voluntarily recalled the product even though the manufacturer did not seem to be responsible for the poisonings. Johnson and Johnson also offered a $100,000 reward for information about the killer and cooperated with authorities investigating the incident.

Tylenol's market share dropped from 35.4 percent to 7 percent as the company recalled products at a cost of $100 million ("Tylenol," 10/2/83). Polls indicated that about half of Tylenol's users thought it unlikely they would use the product again and sales were down 80 percent (Waldholz, 10/29/82). After the heptachlor incident on Oahu, a survey conducted for Foremost indicated that 24 percent of those sampled would buy less milk after the contamination crisis passed, and whole and 2 percent milk purchases were off by about 75 percent. Concerning government's influence on response, one market analyst said:

> Federal Drug Administration's [sic] statements about Tylenol and the company's steps to recall Extra-Strength Tylenol "could have a fairly negative psychological impact on the product in the minds of consumers until the F.D.A. tells them that it is all right to use it again. If the uncertainty goes on for weeks or months, and the F.D.A. does not give the product a clean bill of health, there could be fairly long-lasting damage to the product." (cited in Pace, 10/2/82)

In industry-wide contamination incidents, there is no parent company to act quickly to reassure and protect the public. That role falls on government officials. The results of this study indicate that

government can best protect the long-term interests of the industry by protecting the short-term interests of the consumer and recalling all possibly contaminated product. Losses to the industry cannot be avoided in massive contamination incidents. The question government and industry officials must ask is not how to avoid but how to minimize costs.

Amid uncertainty, officials attempt to reassure the public of little or no health risk associated with the contaminant. However, when officials retract their statements or are proven wrong, they lose credibility precisely at the time they most need it to minimize producer costs. As risk perceptions rise, the public looks for credible sources of information. In both PBB and heptachlor incidents, individuals, whether qualified or not, stated higher health risks associated with the contaminant than did government officials. Unless the government is credible, the information provided by these individuals will lead consumers to reduce consumption since negative information has a greater impact than positive information. Hence negative information freely supplied to consumers leads them to reduce consumption more than it would have been reduced. If the government has lost credibility, it has lost its effectiveness to counter this effect.

Mowen and Pollman (1982) showed that releasing the worst possible information first followed by less alarming releases resulted in more favorable perceptions of the company than when information of possible health risks grew increasingly worse. By maintaining credibility and placing public safety foremost, government officials can

minimize the cost of lost sales to producers as well as the threat to public health. One year after the cyanide poisoning deaths, Tylenol was once again the nation's leading nonprescription pain killer. Sixteen months after the initial milk recall, Oahu dairymen were threatened with a complete loss of market by competition from Safeway.

Analysis of media coverage of the Oahu incident supports these policy implications. Protecting public health by recalling all contaminated product minimizes subsequent recalls, possible injury to consumers, continued media coverage, and attention drawn to the matter. Compared to the Thompson, Eiler, and Forker (1976) study of generic milk advertising in New York City, negative media coverage appears to have an effect of similar magnitude but opposite direction as generic advertising. But rather than present positive information to counter bad publicity, this study indicates that government and industry can best minimize sales loss by removing the perceived health threat. Disputing unfavorable test results only serves to maintain the prominence of the incident and heighten uncertainty surrounding it. Following a contamination incident, a statement such as, "This product does not cause cancer," will draw attention to the possibility of a product's carcinogenicity.

Emergency plans should be prepared before contamination strikes a company or industry. Johnson and Johnson's decisive actions were taken partly because an 18-month review of the company code of ethics at all levels of management had just been completed. The

consensus behind the code helped executives make difficult decisions (Seibert, 12/25/83). Quick action is expected of government agencies especially. A delay in disclosure of contamination in the food supply is a disincentive to later announce the problem because questions about the delay are raised by the press. The longer an official delays in announcing a problem, the more embarrassing it is to announce it. On Oahu, reasons for the delay were part of the investigation of the incident. A principal constraint frequently faced by government agencies involved in these occurrences is a lack of laboratory facilities. Plans for quickly expanding such capacity should be developed. Specific recommendations for industry handling of product recall are available in Fiske and Chandran (1975), McGuire (1974), and Grocery Manufacturers of America (1974).

Market structure will influence the amount of lost sales. Estimated sales loss for Oahu dairymen is low compared to producers of contaminated products with many substitutes. After a man died of botulism poisoning from Bon Vivant vichyssoise in 1971, the company soon filed for bankruptcy (Kleinfield, 1982). Oahu consumers who grew tired of fruit nectar or powdered milk had no alternative but to buy island milk. If an undifferentiated product is contaminated, the cost of lost sales will not be limited to those producers directly involved. Even those whose products were never contaminated will suffer a sales loss. Dairymen on the island of Hawaii suffered a decline in sales even though their herds were not contaminated. Even with differentiated products, other producers will be affected by the

contamination. There is conflicting information about the effects of the 1982 Tylenol poisoning incident on manufacturers of substitute pain relievers. One report indicated sales of competitors' products declined ("Tylenol," 10/9/82) while another reported sales increases (Kneale, 10/13/82).

Barriers to entry will affect sales loss. Fresh milk from other sources was not available given the processor duopoly and government protection of the island dairy industry. Had an alternative fresh milk source been available, the sales loss probably would have been greater. (However, few Oahu consumers tried the small amount of milk imported from the island of Hawaii. It too was apparently suspect.) In the aftermath of Michigan's PBB incident, food products were simply shipped in from surrounding states, and in some cases, clearly advertised as being produced outside Michigan.

Not only will market structure affect consumer response, but consumer response may also affect market structure. The greatest cost to Oahu producers was not lost sales, but a change in market structure. In Hirschman's (1970) terms of exit and voice, Oahu consumers could not easily exit the milk market. Hence they exercised their voice not to pressure producers or processors but to pressure the State to allow competitors into the market. Now that California milk has penetrated the market, the survival of the local industry is threatened. The incident precipitated questioning of the market structure and its protection by consumers, competitors, and federal agencies. This case shows that consumer awareness of food contamination can bring about

more competition in an imperfectly competitive market and provide a powerful producer incentive to maintain product quality even in a protected market with limited substitutes.

Finally, this study shows that the market provides financial incentives not to market an adulterated product, but can reliance be placed on market incentives alone to enforce food safety regulations? Effectiveness of the market to do so may be tempered by non-economic factors. If, as some believe, negative information carries greater weight than positive information because it is rare (see Weinberger, Allen, & Dillon, 1981), the effectiveness of bad publicity on sales of a contaminated product may diminish as more contamination is reported (the "Cancer-of-the-Month" syndrome). As discussed in Chapter Four, response to information about contamination will be affected by the credibility of the source and the predisposition, self-confidence, and risk perceptions of the consumer, which in turn may be influenced by the perceived degree of health risk (e.g., death from botulism), government protection of public health and producer integrity. Characteristics of the populace involved will affect response. Different age and ethnic groups, those of different household compositions, and men and women responded differently to the Oahu incident.

A major problem with relying solely on the market to enforce food safety regulations is that the market punishes indiscriminately and may not hold those responsible for the contamination fully accountable. This study shows that each Oahu dairyman lost milk sales as a result of consumer awareness of the contamination. Yet consumer

confidence in one's undifferentiated product is a collective good. The benefit of acting to ensure consumer confidence cannot accrue solely to the producer who takes action to maintain such confidence. Indeed, despite efforts by some producers to maintain product quality, they may still bear the cost created by another producer who markets a contaminated product. Likewise, the costs of marketing a contaminated product do not accrue to the guilty parties. Hence, producers have incentives to reduce their costs by marketing products of questionable quality and letting the industry as a whole bear the cost. Unless a method is found to impose the cost of marketing a contaminated product on those responsible, market forces alone will not assure consumers a safe food supply.

6.5 Further Research

Much remains to be learned from heptachlor contamination of Oahu milk. The period of observation of this study was too short to determine when milk consumption reached pre-contamination levels. Data indicated that sales remained depressed in the summer of 1983 but may have recovered by January 1984.

The existence of thresholds of awareness and risk and their effects on consumer behavior changes is important. If consumers cannot find adequate substitutes for a contaminated product, they may eventually resume normal purchases of it. If a threshold is crossed though, they may go to great lengths to search for or create new substitutes (e.g., innovations by some with soy and goats' milk were publicized on Oahu), or they may try to change market structure to increase their

options. Had the industry not lost the confidence of consumers and thresholds not been crossed, these courses of action may not have been explored. How much awareness of product contamination is necessary to change consumption was not studied here. It is believed a threshold may have been quickly crossed given four recalls in less than two weeks.

The distributional impacts of this study are many. Of particular interest to producers is to determine a shift in market shares between Meadow Gold, which received much unfavorable publicity, and Foremost. Likewise, there may have been a shift in consumption away from whole to low-fat milk. The extent of this is unknown. Spillover losses to dairymen on the island of Hawaii occurred in response to the Oahu incident even though Hawaiian cows were never contaminated with heptachlor. Determining the extent and duration of losses to them requires price data from the major retailers on the island since no retail price survey is conducted. A problem with such a study is measuring consumer awareness of the contamination since television broadcasts originate on Oahu, but the Hilo, Hawaii, newspaper informed island residents that the contamination was limited to Oahu. Consumers may have received mixed information.

A related topic worthy of investigation is the incident's effect on sales of substitutes and complements. Knowing the benefits that accrued to Real Fresh, Inc., which sold sterilized canned whole milk on Oahu, and to producers of other substitutes would help understand the ripple effect of these incidents through the market.

This is particularly interesting in the Oahu incident because the dairy processors also produced fruit nectar, the leading substitute to milk. Another cost stemming from food contamination is the cost to producers of complements of the contaminated product. It is unknown how sales of breakfast cereals were affected.

This study of consumer response to food contamination quantifies the sales loss from a contamination incident. It indicates that producers do suffer from consumer awareness of the problem which should provide them with incentive to observe food safety regulations. This incentive may be inadequate for market forces alone to enforce food safety regulations unless producers can fully capture the benefits of observance of such regulations or fully pay the costs of their violation. Several factors may influence the sales loss, including market structure and government action (or lack of it) to minimize public health risks. Product contamination may affect a change in market structure, making imperfectly competitive markets more competitive. Attempts to counter bad publicity stemming from the contamination may not help sales recovery. Future research should include an examination of threshold levels of awareness needed to change purchasing behavior and study of the distributional aspects of these incidents. Producer awareness of market incentives to observe food safety regulations in conjunction with government inspection will help ensure food safety.

APPENDICES

APPENDIX ONE

THE DATA

APPENDIX ONE

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Consumption

Monthly data on Oahu milk production and utilization are available only for aggregate forms of utilization. After the contamination, Class I utilization was corrected by several factors. First, the quantity of imports, recorded by the Division of Milk Control, was added. Second, route returns (milk returned from stores and other outlets) were estimated from data provided by one processor. It was assumed route returns reflect the market shares of each processor. Hence Meadow Gold with 59.5 percent of the pre-contamination market accounted for the same percentage of route returns. Foremost accounted for 40.5 percent. In those months when estimated returns exceeded the allowance for plant shrinkage and route returns, as set by the Division of Milk Control, Class I utilization was decreased by the excess returns.

Schools were supplied with imitation milk in the fall to avoid retail fresh milk shortages. To properly reflect quantity demanded, estimated school consumption of fresh milk, had supplies been ample, was added to utilization data. Schools usually received 7,000 gallons of milk a day (Harpham, 9/25/80). The numbers of school days (excluding holidays) in which imitation milk was served were 3 in September,

20 in October, 18 in November, and 13 in December. Calculation of total fresh fluid milk consumption is shown in Table A.1.

Population

On a given day, about 10 percent of the people in Hawaii are tourists. Hence, dividing consumption by resident population yields incorrect per capita figures. Tourist numbers vary with peaks in July and August, and a lesser peak in March. To estimate the number of tourists on Oahu by month, the number of westbound overnight and longer visitors to Oahu and their average length of stay on Oahu were obtained from the Hawaii Visitors Bureau. These data reflect the number of tourists from North America (about three-quarters of all tourists) arriving on Oahu and staying at least overnight. The average length of stay on Oahu for visitors from Asia or Oceania was unavailable, so the number of such tourists was not considered. It was assumed such tourists are not heavy milk drinkers. To calculate the average number of tourists on Oahu each month, the following equations from the Hawaii Visitors Bureau were employed:

Number of Visitors per Month x Average Length of Stay (days) = Number of Visitor-Days per Month

Number of Visitor-Days per Month ÷ Days per Month = Average Daily Visitor Census

This was then added to monthly Oahu resident population, which was interpolated from annual data.

Price Data

Retail prices are sampled weekly on Oahu. Weekly raw data were obtained from the Market News Branch of the Hawaii Department of Agriculture, and the Honolulu Advertiser provided photocopies of its weekly "Retail Food Price Guide." Monthly prices were calculated from the weekly surveys of eight stores for half-gallons of whole and filled milk, and fruit nectar, a 14-quart package of nonfat dry milk, 46 ounces of canned fruit drink, and 12 ounces of canned soda. Often, only one observation was available per month; when there were more, an average was used. Gaps in data were filed by interpolation.

Gaps were minor except for nonfat dry milk and fruit drink when for 19 months (March 1979-October 1980) prices of an eight-quart package of nonfat dry milk and 12 ounces of fruit drink were surveyed. For nonfat dry milk, the 14-quart non-sale price before the interruption in the series was compared to the eight-quart non-sale price at the beginning of the gap. An index was calculated and the eight-quart price was adjusted to approximate the 14-quart price. A five-month gap remained for which prices were interpolated. Similarly for fruit drink, the 46-ounce non-sale price in October 1980 was compared with the non-sale 12-ounce price in the same month to devise an index by which to adjust the 12-ounce price.

Estimating the retail price of fruit nectar over a 20-month gap (February 1975-October 1980) was more difficult. The deflated price of fruit nectar (DPFN) was regressed on the fruit and vegetable component of the Honolulu CPI (CPIFV). Regression results were:

$$DPFN = \underset{(0.0618)}{0.480} + \underset{(0.0224)}{0.280}\ CPIFV$$

$$\bar{R}^2 = 0.735 \qquad D.W. = 1.266$$

Figures in parentheses are standard errors.

Although serial correlation was present, the estimators are unbiased. This equation was then used to estimate fruit nectar prices over the period of missing observations.

It should be noted that the Honolulu CPI is not seasonally adjusted. The Bureau of Labor Statistics does not adjust it because it is based on a small sample, so correcting for seasonality may introduce as much error as not adjusting it.

Table A.1.--Adjusted consumption (pounds), March 1982-June 1983.

		Class I Utilization	Excess Route Returns	Imports	Fall School Supply	Estimated Quantity Demanded
	MAR	4,372,720	0	70,950		4,443,670
	APR	1,394,566	43,241	109,502		1,460,827
	MAY	4,057,917	0	61,122		4,119,038
	JUN	5,317,541	10,079	35,114		5,342,576
	JUL	5,922,509	9,503	0		5,913,006
	AUG	6,098,039	0	0		6,098,039
	SEP	6,407,063	0	0	180,600	6,587,663
	OCT	6,166,634	41,633	15,480	1,204,000	7,344,481
	NOV	6,010,435	12,160	0	1,083,600	7,081,875
	DEC	6,359,002	0	58,050	782,600	7,199,652
1983	JAN	7,642,948	0	0		7,642,948
	FEB	6,960,393	0	0		6,960,393
	MAR	8,446,127	0	0		8,446,127
	APR	8,075,145	0	0		8,075,145
	MAY	8,416,879	49,235	0		8,367,644
	JUN	6,958,749	52,486	0		6,906,263

Table A.2.--Consumption, calendar composition adjustment factors, and milk dumped.

		Fluid Milk Consumption (Oz./Person/Day)[a]	Calendar Composition Adjustment Factor[b]	Milk Dumped (Pounds)[a]
1977	JAN	5.97342	0.9837	0
	FEB	5.80994	1.0000	0
	MAR	5.83109	1.0077	0
	APR	5.56503	1.0162	0
	MAY	5.90165	0.9790	0
	JUN	4.83096	1.0055	0
	JUL	4.93536	0.9844	0
	AUG	4.92175	1.0090	0
	SEP	6.07578	1.0157	0
	OCT	5.86075	0.9837	0
	NOV	5.90973	1.0011	0
	DEC	5.12989	1.0223	0
1978	JAN	5.85154	0.9823	0
	FEB	5.58569	1.0000	0
	MAR	5.64589	1.0129	0
	APR	6.17028	0.9751	0
	MAY	5.85454	1.0099	0
	JUN	5.03486	1.0147	0
	JUL	5.03781	0.9832	0
	AUG	5.07947	1.0094	0
	SEP	5.94753	1.0126	0
	OCT	5.93240	0.9823	0
	NOV	5.73423	1.0057	0
	DEC	5.63509	0.9833	0
1979	JAN	5.67742	1.0087	0
	FEB	5.83686	1.0000	0
	MAR	4.93947	1.2010	0
	APR	6.13927	0.9771	0
	MAY	5.84254	1.0098	0
	JUN	5.32830	1.0128	0
	JUL	5.16711	0.9839	0
	AUG	5.10002	1.0122	0
	SEP	5.75965	0.9743	0
	OCT	5.48121	1.0087	0
	NOV	5.13706	1.0167	0
	DEC	5.70715	0.9817	0

Table A.2.--Continued.

		Fluid Milk Consumption (Oz./Person/Day)[a]	Calendar Composition Adjustment Factor[b]	Milk Dumped (Pounds)[a]
1980	JAN	5.71371	1.0064	0
	FEB	5.72876	1.0485	0
	MAR	5.87161	0.9821	0
	APR	5.92405	1.0022	0
	MAY	5.73991	1.0187	0
	JUN	5.21007	0.9785	0
	JUL	4.94494	1.0064	0
	AUG	5.16567	0.9861	0
	SEP	5.60939	1.0118	0
	OCT	5.56231	1.0140	0
	NOV	5.61365	0.9737	0
	DEC	5.06627	1.0096	0
1981	JAN	5.45618	1.0187	0
	FEB	5.58524	1.0000	0
	MAR	5.25543	0.9831	0
	APR	5.69500	1.0025	0
	MAY	5.69917	0.9861	0
	JUN	4.78825	1.0118	0
	JUL	4.89074	1.0140	0
	AUG	4.96829	0.9821	0
	SEP	5.52542	1.0022	0
	OCT	5.27889	1.0187	0
	NOV	5.20056	0.9785	0
	DEC	4.88222	1.0064	0
1982	JAN	5.13185	0.9840	0
	FEB	5.08804	1.0000	0
	MAR	2.59754	1.0119	3,155,170
	APR	0.88405	1.0153	8,019,060
	MAY	2.50146	0.9822	5,938,650
	JUN	3.22787	1.0031	3,590,020
	JUL	3.39667	1.0178	2,825,120
	AUG	3.63138	0.9846	3,137,140
	SEP	4.07963	1.0018	2,009,870
	OCT	4.42498	0.9840	2,666,900
	NOV	4.26711	1.0148	1,958,750
	DEC	4.20177	1.0124	1,511,190

Table A.2.--Continued.

		Fluid Milk Consumption (Oz./Person/Day)[a]	Calendar Composition Adjustment Factor[b]	Milk Dumped (Pounds)[a]
1983	JAN	4.61417	0.9822	1,165,160
	FEB	4.52604	1.0000	811,148
	MAR	4.90825	1.0071	263,690
	APR	4.86581	1.0141	61,580
	MAY	5.00106	0.9846	31,820
	JUN	4.09559	1.0018	0

[a]Based on data from the Hawaii Department of Agriculture, Division of Milk Control. Consumption adjusted as described in Appendix.

[b]Source: Various issues of the Federal Milk Order Market Statistics (FMOS--221, 233, 243, 258, 285).

Table A.3.--Milk price, fruit nectar price, and consumer price index.

		Deflated Retail Fluid Milk Price ($/1/2 Gal.)[a]	Deflated Fruit Nectar Price ($/1/2 Gal.)[a]	Honolulu Consumer Price Index (1967=100)[b]
1977	JAN	0.649038	0.600962	1.664
	FEB	0.645161	0.603345	1.674
	MAR	0.647653	0.594177	1.683
	APR	0.650888	0.597633	1.690
	MAY	0.641932	0.594817	1.698
	JUN	0.651026	0.545455	1.705
	JUL	0.653061	0.530612	1.715
	AUG	0.643852	0.551044	1.724
	SEP	0.640138	0.582468	1.734
	OCT	0.638298	0.580794	1.739
	NOV	0.636468	0.579128	1.744
	DEC	0.634648	0.577473	1.749
1978	JAN	0.628895	0.577904	1.765
	FEB	0.623596	0.606742	1.780
	MAR	0.639955	0.612131	1.797
	APR	0.639471	0.622933	1.814
	MAY	0.635268	0.629792	1.826
	JUN	0.630778	0.625340	1.839
	JUL	0.633117	0.600649	1.848
	AUG	0.630388	0.581897	1.856
	SEP	0.625000	0.571581	1.872
	OCT	0.625000	0.577331	1.888
	NOV	0.621053	0.605263	1.900
	DEC	0.616832	0.601150	1.913
1979	JAN	0.603715	0.593395	1.938
	FEB	0.606524	0.606524	1.962
	MAR	0.625000	0.630040	1.984
	APR	0.612855	0.597907	2.007
	MAY	0.612043	0.587364	2.026
	JUN	0.616438	0.621331	2.044
	JUL	0.626822	0.612245	2.058
	AUG	0.627413	0.593629	2.072
	SEP	0.627395	0.589080	2.088
	OCT	0.627078	0.579572	2.105
	NOV	0.625294	0.578279	2.127
	DEC	0.619181	0.558659	2.148

Table A.3.--Continued.

		Deflated Retail Fluid Milk Price ($/1/2 Gal.)[a]	Deflated Fruit Nectar Price ($/1/2 Gal.)[a]	Honolulu Consumer Price Index (1967=100)[b]
1980	JAN	0.610652	0.550964	2.178
	FEB	0.602082	0.543232	2.209
	MAR	0.611062	0.544157	2.242
	APR	0.602463	0.532102	2.274
	MAY	0.606860	0.540897	2.274
	JUN	0.606593	0.545055	2.275
	JUL	0.603147	0.537587	2.288
	AUG	0.643199	0.547588	2.301
	SEP	0.636833	0.546472	2.324
	OCT	0.639386	0.575448	2.346
	NOV	0.641734	0.611985	2.353
	DEC	0.639560	0.614147	2.361
1981	JAN	0.629954	0.600751	2.397
	FEB	0.678175	0.591862	2.433
	MAR	0.668829	0.579651	2.467
	APR	0.660000	0.560000	2.500
	MAY	0.656325	0.536993	2.514
	JUN	0.648734	0.534019	2.528
	JUL	0.647821	0.530035	2.547
	AUG	0.643024	0.518316	2.566
	SEP	0.647538	0.387747	2.579
	OCT	0.644042	0.528346	2.593
	NOV	0.645286	0.568006	2.588
	DEC	0.646535	0.530391	2.583
1982	JAN	0.641814	0.511145	2.602
	FEB	0.637405	0.515267	2.620
	MAR	0.635948	0.521706	2.626
	APR	0.634258	0.516521	2.633
	MAY	0.597295	0.503381	2.662
	JUN	0.617100	0.371747	2.690
	JUL	0.616642	0.523774	2.692
	AUG	0.619896	0.530809	2.694
	SEP	0.613294	0.495777	2.723
	OCT	0.606831	0.505087	2.752
	NOV	0.612844	0.554128	2.725
	DEC	0.611338	0.566877	2.699

Table A.3.--Continued.

		Deflated Retail Fluid Milk Price ($/1/2 Gal.)[a]	Deflated Fruit Nectar Price ($/1/2 Gal.)[a]	Honolulu Consumer Price Index (1967=100)[b]
1983	JAN	0.583486	0.535780	2.725
	FEB	0.600000	0.563636	2.750
	MAR	0.586957	0.514493	2.760
	APR	0.566787	0.516245	2.770
	MAY	0.564047	0.491266	2.748
	JUN	0.557594	0.502568	2.726

[a]From the Hawaii Department of Agriculture, Market News Branch, and the Honolulu Advertiser weekly "Retail Food Price Guide."

[b]Based on data from U.S. Department of Commerce, Bureau of Labor Statistics, CPI Detailed Report, various issues.

Table A.4.--Hawaii state personal income, resident population, and per capita personal income.

		Nominal State Personal Income[a] (Millions of Dollars)	Resident Population[b]	Deflated Per Capita Personal Income
1977	JAN	6548	909000	4329.04
	FEB	6653	910167	4366.58
	MAR	6758	911333	4406.13
	APR	6787	912500	4401.07
	MAY	6815	913667	4392.79
	JUN	6844	914833	4387.77
	JUL	6894	916000	4388.46
	AUG	6945	917083	4392.65
	SEP	6995	918167	4393.56
	OCT	7098	919250	4440.20
	NOV	7200	920333	4485.81
	DEC	7303	921417	4531.64
1978	JAN	7345	922500	4511.08
	FEB	7388	923583	4493.98
	MAR	7430	924667	4471.52
	APR	7490	925750	4460.16
	MAY	7549	926833	4460.54
	JUN	7609	927917	4458.99
	JUL	7713	929000	4492.68
	AUG	7816	930750	4524.53
	SEP	7920	932500	4537.02
	OCT	8004	934250	4537.76
	NOV	8087	936000	4547.35
	DEC	8171	937750	4554.84
1979	JAN	8231	939500	4520.66
	FEB	8291	941250	4489.55
	MAR	8351	943000	4463.60
	APR	8423	944750	4442.25
	MAY	8496	946500	4430.52
	JUN	8568	948250	4420.54
	JUL	8665	950000	4432.00
	AUG	8761	951583	4443.42
	SEP	8858	953167	4450.78
	OCT	8938	954750	4447.32
	NOV	9018	956333	4433.37
	DEC	9098	957917	4421.64

Table A.4.--Continued.

		Nominal State Personal Income[a] (Millions of Dollars)	Resident Population[b]	Deflated Per Capita Personal Income
1980	JAN	9276	959500	4438.72
	FEB	9453	961083	4452.59
	MAR	9631	962667	4462.31
	APR	9651	964250	4401.41
	MAY	9672	965833	4403.76
	JUN	9692	967417	4403.71
	JUL	9785	969000	4413.48
	AUG	9878	969833	4426.45
	SEP	9971	970667	4420.10
	OCT	10081	971500	4423.16
	NOV	10191	972333	4454.30
	DEC	10301	973167	4483.28
1981	JAN	10362	974000	4438.30
	FEB	10424	974833	4395.03
	MAR	10485	975667	4356.10
	APR	10547	976500	4320.33
	MAY	10608	977333	4317.43
	JUN	10670	978167	4314.94
	JUL	10774	979000	4320.81
	AUG	10877	980225	4324.41
	SEP	10981	981450	4338.33
	OCT	11057	982675	4339.35
	NOV	11134	983900	4372.56
	DEC	11210	985125	4405.45
1982	JAN	11239	986350	4379.15
	FEB	11268	987575	4354.87
	MAR	11297	988800	4350.71
	APR	11370	990025	4361.78
	MAY	11442	991250	4336.21
	JUN	11515	992475	4313.13
	JUL	11589	993700	4332.27
	AUG	11664	994975	4351.49
	SEP	11738	996250	4326.91
	OCT	11747	997525	4279.12
	NOV	11756	998800	4319.31
	DEC	11765	1000080	4358.69

Table A.4.--Continued.

		Nominal State Personal Income[a] (Millions of Dollars)	Resident Population[b]	Deflated Per Capita Personal Income
1983	JAN	11853	1001350	4343.86
	FEB	11940	1002630	4330.45
	MAR	12028	1003900	4341.04
	APR	12102	1005180	4346.46
	MAY	12176	1006450	4402.46
	JUN	12250	1007730	4459.32

[a]Based on data from U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, April 1983, October 1983, and January 1984.

[b]Based on data from Hawaii, Department of Planning and Economic Development, State of Hawaii Data Book 1983.

Table A.5.--Visitors to Oahu, average length of stay, and average daily visitor census.[a]

		Westbound Overnight and Longer Visitors	Average Length of Stay	Average Daily Visitor Census
1977	JAN	197940	6.03	38502.5
	FEB	188767	6.06	40854.6
	MAR	211506	5.77	39367.4
	APR	186099	5.66	35110.7
	MAY	162989	5.73	30126.7
	JUN	203772	6.06	41161.9
	JUL	218362	6.08	42827.1
	AUG	228109	5.88	43267.1
	SEP	160662	5.54	29668.9
	OCT	178760	5.94	34252.7
	NOV	162717	5.49	29777.2
	DEC	195630	6.32	39883.3
1978	JAN	197674	5.96	38004.4
	FEB	193618	6.02	41627.9
	MAR	226525	5.71	41724.4
	APR	185866	5.66	35066.7
	MAY	170781	5.55	30575.3
	JUN	217595	6.01	43591.5
	JUL	238373	6.15	47290.1
	AUG	235232	5.79	43935.3
	SEP	186228	5.47	33955.6
	OCT	213348	5.74	39503.8
	NOV	213608	5.71	40656.7
	DEC	216045	6.25	43557.5
1979	JAN	232118	6.12	45824.6
	FEB	225847	5.84	47105.2
	MAR	236688	5.70	43520.1
	APR	185714	5.54	34295.2
	MAY	161154	5.65	29371.6
	JUN	216684	6.10	44059.1
	JUL	247185	6.21	49516.7
	AUG	262311	5.87	49669.9
	SEP	188217	5.69	35698.5
	OCT	201564	5.78	37581.9
	NOV	182581	5.55	33777.5
	DEC	202654	6.14	40138.6

Table A.5.--Continued.

		Westbound Overnight and Longer Visitors	Average Length of Stay	Average Daily Visitor Census
1980	JAN	194093	5.98	37441.2
	FEB	195294	5.87	39530.2
	MAR	224540	5.68	41141.5
	APR	188490	5.52	34682.2
	MAY	177902	5.50	31563.3
	JUN	212831	5.88	41714.9
	JUL	263799	6.23	53015.1
	AUG	238713	5.79	44585.4
	SEP	154597	5.53	28497.4
	OCT	176023	5.62	31911.3
	NOV	172714	5.47	31491.5
	DEC	199741	6.24	40205.9
1981	JAN	181273	6.09	35611.4
	FEB	195612	5.80	40519.6
	MAR	196019	5.58	35283.4
	APR	187020	5.69	35471.5
	MAY	183508	5.54	32794.7
	JUN	225276	6.25	46932.5
	JUL	229850	6.27	46489.0
	AUG	257381	5.98	49649.6
	SEP	171610	5.79	33120.7
	OCT	190622	5.63	34619.4
	NOV	178100	5.74	34076.5
	DEC	202206	6.60	43050.3
1982	JAN	205932	6.23	41385.7
	FEB	218725	5.86	45776.0
	MAR	247247	5.68	45302.0
	APR	216120	5.61	40414.4
	MAY	200076	5.77	37240.0
	JUN	250069	6.05	50430.6
	JUL	267627	6.07	52403.1
	AUG	264963	5.75	49146.4
	SEP	194847	5.53	35916.8
	OCT	214040	5.54	38251.0
	NOV	218054	5.35	38886.3
	DEC	204955	5.93	39205.9

Table A.5.--Continued.

		Westbound Overnight and Longer Visitors	Average Length of Stay	Average Daily Visitor Census
1983	JAN	195057	5.62	35361.9
	FEB	214920	5.51	42293.2
	MAR	250658	5.48	44309.9
	APR	191806	5.47	34972.6
	MAY	209499	5.62	37980.1
	JUN	279346	6.06	56427.9

[a]Source: Hawaii Visitors Bureau.

Table A.6.--Oahu resident population and de facto population.

		Oahu Resident Population[a]	De Facto Population
1977	JAN	729900	768403
	FEB	730550	771405
	MAR	731200	770567
	APR	731850	766961
	MAY	732500	762627
	JUN	733150	774312
	JUL	733800	776627
	AUG	734342	777609
	SEP	734883	764552
	OCT	735425	769678
	NOV	735967	765744
	DEC	736508	776391
1978	JAN	737050	775054
	FEB	737592	779220
	MAR	738133	779857
	APR	738675	773742
	MAY	739217	769792
	JUN	739758	783350
	JUL	740300	787590
	AUG	741442	785377
	SEP	742583	776539
	OCT	743725	783229
	NOV	744867	785524
	DEC	746008	789565
1979	JAN	747150	792975
	FEB	748292	795397
	MAR	749433	792953
	APR	750575	784870
	MAY	751717	781089
	JUN	752858	796917
	JUL	754000	803517
	AUG	754917	804587
	SEP	755833	791531
	OCT	756750	794332
	NOV	757667	791444
	DEC	758583	798722

Table A.6.--Continued.

		Oahu Resident Population[a]	De Facto Population
1980	JAN	759500	796941
	FEB	760417	799947
	MAR	761333	802475
	APR	762250	796932
	MAY	763167	794730
	JUN	764083	805798
	JUL	765000	818015
	AUG	765233	809818
	SEP	765467	793964
	OCT	765700	797611
	NOV	765933	797425
	DEC	766167	806373
1981	JAN	766400	802011
	FEB	766633	807153
	MAR	766867	802150
	APR	767100	802571
	MAY	767333	800128
	JUN	767567	814499
	JUL	767800	814289
	AUG	768417	818067
	SEP	769033	802154
	OCT	769650	804269
	NOV	770267	804343
	DEC	770883	813933
1982	JAN	771500	812886
	FEB	772117	817893
	MAR	772733	818035
	APR	773350	813764
	MAY	773967	811207
	JUN	774583	825014
	JUL	775200	827503
	AUG	776108	825254
	SEP	770017	805934
	OCT	777925	816176
	NOV	778833	817719
	DEC	779742	818948

Table A.6.--Continued.

		Oahu Resident Population[a]	De Facto Population
1983	JAN	780650	816012
	FEB	781558	823851
	MAR	782467	828776
	APR	783275	818248
	MAY	784283	822263
	JUN	785192	841520

[a]Based on data from Hawaii Department of Planning and Economic Development, State of Hawaii Data Book 1983.

APPENDIX TWO

CONTENT ANALYSIS OF OAHU NEWSPAPER ARTICLES

APPENDIX TWO

CONTENT ANALYSIS OF OAHU NEWSPAPER ARTICLES

The purpose of this study was to determine how consumer awareness of milk safety affects fluid milk demand. To this end, variables representing information presented to the public about the contamination incident were included in the model.

Awareness of milk safety has three components: awareness of milk quality, the level of state protection of consumer health, and processor integrity. Milk quality refers to its physical characteristics, especially the presence or absence of harmful organisms or chemicals. The level of state protection of consumer health refers to the efforts and ability of the government to ensure a safe milk supply and keep adulterated products off the market. Processor integrity reflects concern and action taken by the processors to ensure safe milk. Awareness of milk safety may arise from friends, family, and the mass media. This study measured the amount and direction of information (positive, negative, or neutral) presented to the public by the mass media as a proxy for that from all sources.

Selection of the appropriate media was limited by the data available. Of the three major Oahu television networks, one cooperated by approximating the monthly number of news reports relating to milk

contamination aired from March 1982 through June 1983, as well as reports about the importation of Safeway milk from March through June 1983. Another station provided data only through 1982 while a third was uncooperative. These reports could not be coded whether they reported milk safety positively, negatively, or otherwise. The two major Oahu newspapers, The Honolulu Advertiser and The Honolulu Star-Bulletin, provided photocopies of articles related to milk and the contamination incident. Reports in the Final edition of the Advertiser and the Home edition of the Star-Bulletin were used since they are for home delivery on Oahu and street sales on Oahu and other islands. Relevant articles were those that mentioned "milk," "dairy," "heptachlor," or other contaminants (e.g., antibiotics, DDT) in the headline or first two paragraphs. An exception to this rule were those articles on dairy management-labor negotiations and federal milk fee assessments. These related more to business and labor unions than to milk safety and were excluded.

The analyst cannot assume that an article's content will affect all persons similarly. Hence, one cannot code the articles in terms of their effects on consumers (e.g., creates doubts about, or enhances confidence in milk safety). One can code the articles based on whether they present positive or negative information about milk safety more confidently, and this was pursued.

Articles were coded conservatively, from the viewpoint of a concerned consumer who accepts federal "action" (permissible) levels as safe until even federal agencies question their adequacy. Hence, the

announcement that heptachlor levels fell below the action level was coded positively. An exception to this was two articles announcing the discovery of DDT in nonviolative levels in milk. DDT is a more familiar poison, whose presence in even small amounts was considered negative information.

Mention of current wrongdoing was coded negatively; the direction of reports of past wrongdoing was more equivocal. Reports of unethical behavior ten years in the past probably do not affect awareness of current food product safety. Mention of such behavior within the past six to twelve months may affect awareness of food safety, but its specific effect is uncertain and varies between individuals. Mention of past contamination and wrongdoings by State officials or processors more than one month ago was not considered negative information. (The problem was identified and presumably corrected.) If, however, wrongdoings which had not been corrected were reported, it was coded negatively.

When uncertain about the direction of an article, each sentence was analyzed to determine whether it was positive, negative, or neutral information. Respective weightings were +1, -1, and zero. The article's headline was double counted. The sum of all coding determined how the article was coded. It was recognized that actions and statements by certain sources have more credibility and impact than those of others. Unfamiliar with Hawaiian officials, I did not attempt to account for this.

The following are the coding rules used. An article was coded as positive media coverage, or positive information about milk quality by mentioning:

-levels of contaminants below the action level that were previously above,

-how the presence of the contaminant was not harmful,

-government announcement that the crisis was over,

-government announcement that the dairy farms were clear of contamination,

-others' positive attitudes toward local milk.

Negative information about milk quality was mention of:

-current presence of contaminant in Oahu milk above the action level,

-dangers of the contaminant or uncertainty of the dangers,

-questioning of the adequacy of the action level by federal agencies,

-calls for a lower action level,

-product recall and banning on airlines,

-revelation of longer exposure period than originally suspected,

-doubts, suspicions of milk quality (e.g., about the length of exposure to contaminant),

-others' concerns about milk quality,

-presence of DDT, even below the action level.

Positive media coverage, or positive information concerning the current level of state protection of consumer health by ensuring safe milk supplies, was mention of the following:

-precautionary action taken to protect the public (e.g., recall when the health director suspected wrongdoing by Meadow Gold),

-the first milk recall for heptachlor (other recalls contradicted earlier assurances of safe milk supplies),

-recalls for antibiotics,

-testing and improvement of laboratory facilities,

-invitation of outside help (e.g., FDA expert),

-an investigation into the incident,

-lowering of the action level,

-state officials' certainty of milk safety (first time only),

-resignations ("The rascals are gone.").

Negative media coverage of the level of state protection involved:

-government allowance of violative levels of contaminants,

-government interest more in industry welfare than public safety (e.g., delay in recalling milk. This did not include denial of Safeway's license in 1983, which was seen as more a matter of protecting island business than a health matter.),

-revelation of past incompetence, or mixed priorities with no indication of correction,

-government statements proven false, contradictory lab results from other labs,

-inaction, indecision, confusion on the part of the State,

-accusations of a cover-up.

Positive information about processor integrity was:

-openness and cooperation with state officials,

-openness with public (e.g., creating a telephone answer line),

-voluntary action to ensure milk safety (e.g., independent testing),

-clearance from investigations.

Negative information was:

-lack of openness and cooperation with state officials,

-destruction of records,

-illegal or intentional use of contaminated milk within the past month,

-suspicions, investigations, and accusations made about both processors.

If only one processor was criticized, the article was coded neutral for processor integrity.

Each article was coded positive, negative, or neutral with respect to overall milk safety. Positive (negative) information about milk safety was positive (negative) information about milk quality, level of state protection, and processor integrity. Sometimes there was combination of positive and negative components of milk safety. Information on milk quality was of prime importance in determining the direction of the article with respect to milk safety. If milk on the shelf was known to be contaminated, awareness of milk safety would have

been negative, regardless of the level of State protection and processor integrity. The level of government protection was of secondary importance and overrode information about processor integrity. If the article reported unethical processor behavior and State action to correct it, the article was coded positively for overall milk safety.

To reflect the prominence editors give a story in terms of placement within the paper, position on the page, size of headline and length of story, Budd (1964) developed an "Attention Score." This was used (with slight modifications) to reflect the prominence of the article, and hence attention given it by the reader. Items were weighted as follows (taken from p. 260):

1. One point is assigned to any article with a headline two columns or more in width, except that an article carrying a headline that occupies horizontally more than half the number of columns of the page is assigned two points. [One point is assigned stories whose headline is to the side of the story.]
2. One point is assigned to any story appearing above the fold or above the measured center of any page. To be considered above the fold, the first line of the body text of the story has to appear above the fold.
3. One point is assigned to any article occupying three-fourths of a column or more (based on the column length of the newspaper concerned). For purposes of assigning the attention score, pictures accompanying articles are measured as part of the over-all length of the story.
4. One point is assigned for any article appearing on page one, the editorial page, or the front page of a section.

Hence an article may be scored between zero and five. Pictures and cartoons without an accompanying article are scored in the same manner. Pictures and cartoons accompanying an article are considered part of the story and are included in measurement of the article's overall length, as are the headlines.

Scores and confidence in them are given in Table B.1.

Table B.1.--Components of media coverage.[a]

		NM	Average Confidence	PM	Average Confidence	NEUM	Average Confidence	TM
1982	MAR	92	3.5	34	3.5	52	3.6	178
	APR	122	3.6	60	3.6	54	3.7	236
	MAY	14	3.6	33	3.6	30	3.6	77
	JUN	6	3.4	5	3.4	13	4.0	24
	JUL	10	3.7	9	3.9	14	3.2	33
	AUG	85	3.4	11	3.2	8	3.8	104
	SEP	25	3.5	28	3.5	12	4.0	65
	OCT	6	3.5	12	3.5	7	3.9	25
	NOV	0		0		0		0
	DEC	18	3.8	9	3.8	16	3.5	43
1983	JAN	8	3.3	1	4.0	23	3.9	32
	FEB	8	3.3	5	3.7	19	3.7	32
	MAR	0		0		38	3.9	38
	APR	13	3.5	5	4.0	38	3.8	56
	MAY	16	3.6	14	3.9	84	3.9	114
	JUN	10	3.7	4	3.8	36	3.9	50

[a]NM = Negative media
PM = Positive media
NEUM = Neutral media
TM = Total media

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