Indicative Measures of Health Risk Information on Fat and Cholesterol for U.S. and Japanese Consumers

This paper deals with the measurement of the consumer's health risk information on fat and cholesterol in Japan and the U.S. A new index is specified based on the numbers of articles related to fats and cholesterol published in medical journals in English (for the U.S.) or in Japanese (for Japan). In considering the carryover effect of published medical articles on the consumer's health risk belief, alternative weighting methods are employed rather than an ad-hoc accumulation method. These new indexes show strikingly different historical patterns of health information than either time trend or a simpler index.

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The issue of diet and health has been a major concern not only to consumers but also to those involved in the food industry. However, it is not clear how much the consumer knows about the relationship between diet and health. On the basis of vast medical and dietary research on diet and health, increasing health information has become available to consumers through such sources as health professionals (contact with doctors and nutritionists) and mass media. In the meantime, there have been drastic changes in the consumption patterns of many foods, notably red meats vs. white meats, whole milk vs. low fat milk, and vegetable oils vs. animal fats. All these observed trends prompted many economists to hypothesize a strong relationship between health risk concerns and food consumption.

Several demand studies of U.S. fats and oils (e.g.,Yen and Chern, 1992; and Chern, et al., 1995), found that the consumer's health risk information on cholesterol has induced significant increases in the consumption of vegetable oils (soybean, corn and cottonseed oils) and decreases in the consumption of animal fats (butter and lard). However, this subject of health and diet remains controversial. There were conflicting evidences regarding the impacts of health concerns on the demand structure of foods with high content of fat and cholesterol (e.g., Eales and Unevehr, 1993).

To some extent, this methodological issue in investigating the structural change in consumer demand was caused by the measurement problem of health concerns. Since most demand studies used time-series data (monthly or annually), researchers need to construct the health information data over a historical period. The methodology of constructing such historical series represents a challenge to researchers working in this field. The methods used by Brown and Schrader (1990), and Chern and Zuo (1995) are far from perfect. The purpose of this study is to extend the previous methods by introducing a more realistic specification of the carry-over effects of published information and to employ these alternative methods to construct the information indexes for U.S. and Japan. Since Japanese have a longer life expectancy and have consumed less fats and oils on a per capita basis than Americans, it is interesting and important to compare whether consumers in Japan possess a different pattern of changes in health information about fats and cholesterol than those in the U.S.

Type and Source of Health Information

Information can be classified by type, e.g., biased vs. unbiased, accurate vs. inaccurate, or favorable vs. unfavorable. Weinberger and Dillon (1980) argued that unfavorable product information may be more effective than a similar amount of favorable information. Evidently, the source and type of information have different impacts on the consumer's decision making. Engel and Blackwell (1982) suggested that, in general, personal and neutral information are more influential than the same amount of nonpersonal and market oriented non-neutral information. It is generally accepted that information obtained from personal interaction with someone such as a doctor is considered more effective than information obtained directly from the news media. Furthermore, neutral information, such as that obtained from a doctor and other objective sources are more effective than non-neutral information obtained from advertising and other market oriented sources.

Basic medical and dietary research articles are the primary sources of consumer health information. The health information from the basic medical and dietary articles is conveyed to consumers through (1) health professionals including doctor, nurse, nutritionist, and dietitian, (2) mass media such as television and newspapers, and (3) food industry. Mass media conveys both neutral (news report) and nonneutral (advertising) health information to consumers, while health professionals convey more neutral information. The consumer's health information from these sources may affect their health risk belief toward the products, hence alter their consumption decision. This analysis of health information provides a justification for constructing the Fat and Cholesterol Information Indices using the number of articles related to fats and cholesterol published in medical journals.

Alternative Measures of Health Information

Recently, potential health risks associated with fat and cholesterol intakes have received increasing attention among consumers. However, despite of this apparent trend, how to quantify the degree of the consumer's changing health concern has been a difficult methodological problem. One of the most widely used methods is to incorporate a time variable as a measure of the increasing trend of consumer health information.

In order to provide a better proxy of consumers' health information than a time trend variable, Brown and Schrader (1990) constructed their Cholesterol Information Index denoted as CHOL, a quarterly time-series variable for 1966-1987 by simply accumulating the numbers of published medical articles supporting a link between cholesterol and arterial diseases, minus the number of articles questioning such a link. The basic idea underlying this index is that the articles published in major medical journals are the basic sources of health information which is conveyed to consumers through health professionals and mass media.

Another empirical study using the CHOL was conducted by Yen and Chern (1992). From the estimated results, they suggested that using this information variable does provide an additional account of the consumption shift from animal fats to vegetable oils, which in some cases can not be explained by prices and total expenditure alone.

Similar to the CHOL, Chern and Zuo (1995) developed the Fat and Cholesterol Information Index(FCII) using different key words and a new weighting method under the assumption that an article published in a specific time period has both carry over and decay effects. Specifically, their FCII was defined as a weighted sum of the number of articles published in all English medical journals linking fat(s),and cholesterol to heart disease or arteriosclerosis. A third degree polynomial weighting function was employed to obtain the weights and a one year lag period was selected by tracking the relationship between the number of articles published in the Washington Post and those published in medical journals.

In analyzing the effects of health risk information on such foods with high contents of fats and cholesterol as red meats, dairy products, animal fats and vegetable oil, Chern and Zuo's choice of key words, including fat(s), seems to be more complete than those used by Brown and Schrader. Furthermore, in contrast to Brown and Schrader's index, Chern and Zuo included all English articles published in medical journals from other countries including England, Canada, and other European countries because they are also important information sources affecting American health professionals and public media. They incorporated this index to evaluate the effect of U.S. consumers' health risk information related to fats and cholesterol on the consumption of fresh milk and dairy products.

As will be described in more detail later, the methods employed by Brown and Schrader (1990) and Chern, et al. (1995) made use of the numbers of the medical articles in supporting vs. not-supporting the linkage between the cholesterol and heart diseases. It was recently found that the number of articles finding no linkage has decreased dramatically in recent years since 1988, the last year included in their sample. Therefore, the methodology involving the distinction of supporting vs. not-supporting articles would become less useful for predicting the future information on health concerns related to fat and cholesterol. A method based on the total number of medical articles such as the one employed by Chern and Zuo would be more appropriate for future prediction. Therefore, this study attempts to update and extend the index developed by Chern and Zuo (1995).

Methodology

Brown and Schrader (1990) hypothesized that the consumer's attitude toward cholesterol changed slowly as scientific information accumulated over time. Their cholesterol information index (CHOL), a quarterly time-series variable for 1966-1987, was constructed by (1) scanning all articles in English connecting the links between diet cholesterol, serum cholesterol and heart disease or arteriosclerosis, (2) discarding irrelevant articles focused on smoking, obesity, alcohol abuse, or linked cholesterol with eye, joint, skin, or gall bladder disease, (3) discarding all Scandinavian, British and Canadian articles based on the belief that they are less likely to be read by U.S. physicians, and (4) simply accumulating the numbers of articles supporting the linkage minus those non-supportive or attacking the linkage, using equal weights for these two types of articles. Furthermore, they selected a two-quarter lag period, assuming that there is likely to be a 6-month lag between the time a new article is published and the time it has an effect on egg consumption. They did not consider any decay pattern for published articles.

In this study, we adopt and expand the methodology developed by Brown and Schrader(1990), and Chern and Zuo(1995), to construct the Fat and Cholesterol Information Indices (FCII) using the number of articles published in medical journals from the MEDLINE data base.

In constructing the U.S. version of the FCII, we selected medical articles relevant to U.S. consumers' health concern associated with fat and cholesterol using the same search key words: fat, cholesterol, and heart disease or arteriosclerosis as those used by Chern and Zuo(1995). Evidently, "fat" is an important key word ignored by Brown and Schrader (1990), which is considered to be crucial for the demand study for foods with high contents of fat and cholesterol. Their data series is updated to cover the period from 1965 to 1994 in this study. All medical articles written in English are scanned for selecting the relevant articles. Also we do not discard these articles linking cholesterol with eye, joint and skin, etc.

For the Japanese version of FCII, we selected medical articles relevant to Japanese consumers' health concern about fat and cholesterol using the search key words: (fat or cholesterol), (heart disease or arteriosclerosis or cerebral or stroke), and (Japan or Japanese). By adding the keywords "Japan or Japanese," only articles published in Japanese medical journals, written by Japanese researchers, or used Japanese data would be selected. In addition, the key word "stroke" is also included because Japanese have been more concerned about stroke than have Americans.

We first extend the method used by Brown and Schrader(1990) by considering the differentiated carryover weights for supporting and attacking articles. Specifically, the FCII is initially expressed as:

$$FCII_t = \sum_{i=0}^{n_S} w_{S_i} NS_{t-i} - \sum_{i=0}^{n_A} w_{A_i} NA_{t-i} \qquad (1)$$

where NS_t and NA_t are the numbers of articles supporting and attacking the linkage at period t (monthly) respectively, w_{Si} and w_{Ai} are the corresponding carryover weights, and n_S and n_A are the numbers of carry-over periods. The carryover weights w_{Si} and w_{Ai} and can be specified as functions of carryover period i and vectors of parameters θ_S and θ_A respectively as:

$$w_{Si} = g_S(i;\ \theta_S) \quad \text{and} \quad w_{Ai} = g_A(i;\ \theta_A) \qquad (2)$$

As suggested by Weinberger and Dillon(1980), supporting articles(unfavorable information) may be more influential than a similar amount of attacking articles(favorable information). Therefore, the carryover weights and periods of supporting and attacking articles may be differentiated. However, supporting and attacking articles are not differentiated in this study because the number of attacking articles has been very low and decreasing (less than 3%). In this study, all articles scanned are considered as relevant articles. Therefore, Eq. (3) may be rewritten as:

$$FCII_t = \sum_{i=1}^{n} w_i NM_{t-i} \qquad (3)$$

where NM_t is the total number of relevant articles at period t, n is the total number of carryover periods of a published article and w_i is the weight for the lagged period i. For $n = 12$, an article as a source of consumer information, will last for 12 months after it is published.

It is not obvious how to determine the duration of the effectiveness of a published article and its pattern of carryover effects. Indeed it has become somewhat controversial as to how one should calculate the carryover weights and duration. One of the most widely used methods for generating carryover weights is based on quadratic or second degree polynomial function used previously by Ward and Dixon(1989) in analyzing the effects of advertising. However, second degree polynomial function may not be appropriate for constructing the fat and cholesterol information index because this function generates symmetric weights.

Chern and Zuo(1995) used the cubic or third degree polynomial weight function (CWF) for constructing the FCII as:

$$w_i = g(i;\ \theta) = \gamma_0 + \gamma_1 i + \gamma_2 i^2 + \gamma_3 i^3 \qquad (4)$$

where θ is a vector of coefficients characterizing the cubic or third degree polynomial weight function. They determined the values of these coefficients(γ_i's) based on the following restrictions: (1) the maximum weight lies somewhere between the current period ($i=0$) and the last carryover period ($i = n+1$); (2) the minimum weights occurs at the last carryover period and can be set to zero, and (3) the sum of weights over the current and carryover periods is equal to 1. This index is denoted as FCII-CWF.

By selecting the number of total carryover period (n) and the carryover period with the maximum weight(m), Chern and Zuo constructed the FCII-CWF using Eq.(3). However, the restrictions they used in determining the coefficients(γ_i's) of cubic weight function may be problematic because a medical article published several years ago (e.g. 10 years) may still affect the current health knowledge of doctors and thus, of consumers.

Therefore, we propose to construct the FCII using the following geometrically declining weight function (GWF):

$$w_i = g(i; \theta) = \alpha\left(\frac{1}{1+d}\right)^i \qquad (5)$$

where d is decaying rate, i is carryover period. Accordingly, the new version of the FCII can be constructed using the following formula:

$$FCII_t = \sum_{i=0}^{n} \alpha\left(\frac{1}{1+d}\right)^i NM_{t-i} \qquad (6)$$

This index is denoted as FCII-GWF.

Results

The procedures developed above are used to construct the health information indexes about fat and cholesterol in the U.S. (English articles) and Japan (Japanese articles).

Using the numbers of articles identified in the Medline data base, we construct the FCII-CWF indexes by selecting the carryover period (n) i.e., number of months in this case, and the maximum effect occurring month (m). The choices and combinations of n and m can be infinite. We tried many versions of this index and found the general trend of this index remains relatively stable.

Figure 1 shows the monthly FCII-CWF indexes constructed for the U.S. for the cases of n = 12, m = 2. This index clearly exhibits fluctuation of consumer health information over time, distinctively different from the time trend or the CHOL. The graph shows there are lower peaks occurring around 1972 and the highest peaks occurring in late 1980s right after the National Cholesterol Education Program launched in 1986. Note that the number of published relevant articles peaked in 1988 with 79 articles. The numbers gradually decreased to 53 articles in 1993 and 72 articles in 1994. Consequently, the graph shows the index actually declined in recent years after 1990.

Figure 1. Fat and Cholesterol Information Index (FCII-CWF) in the U.S.

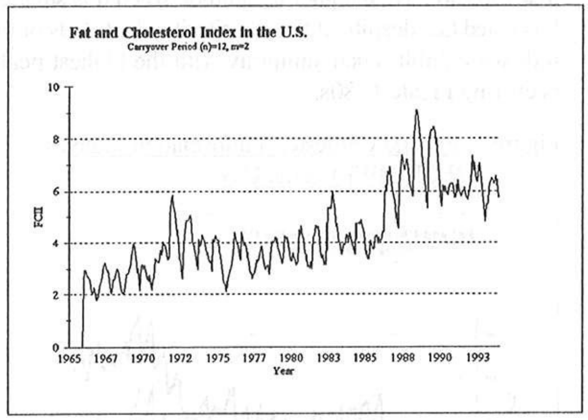


Figure 2. Fat and Cholesterol Information Index (FCII-CWF) in Japan.

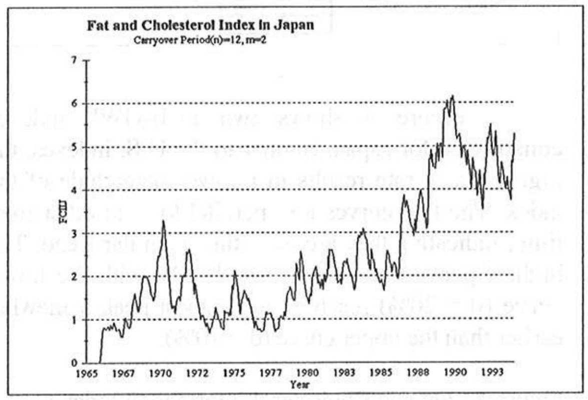


Figure 2 shows the monthly FCII-CWF index constructed using Japanese data. Japanese data show somewhat lower numbers of articles published over this sample period than the number of English articles used to construct the U.S. indexes. Interestingly, however, the Japanese index shows a very similar patterns of trend with lower peaks occurring in early 1970s and the highest peaks in late 1980s. There was a very sharp increasing trend during 1980s, particularly in the late 1980s. This similarity is perhaps expected because of the closeness in medical research between U.S. and Japan.

In order to construct the FCII-GWF, we need to select the decay rate d. Using the same set of data from the Medline, we constructed the monthly FCII-GWF indexes for U.S. and Japan with different values of d. The results show the indexes are very sensitive to the choice of d. Figure 3 shows two indexes constructed for the U.S. with d = 10%, and d = 20%. For a larger d, the effectiveness of a published article as a source of information decreased faster over time. Therefore, the index would have a higher magnitude when d is smaller. It is noted that despite of this sensitivity, the trends of the indexes exhibit much similarity with the highest peaks occurring in late 1980s.

Figure 3. Fat and Cholesterol information Indexes (FCII-GWF) in the U.S.

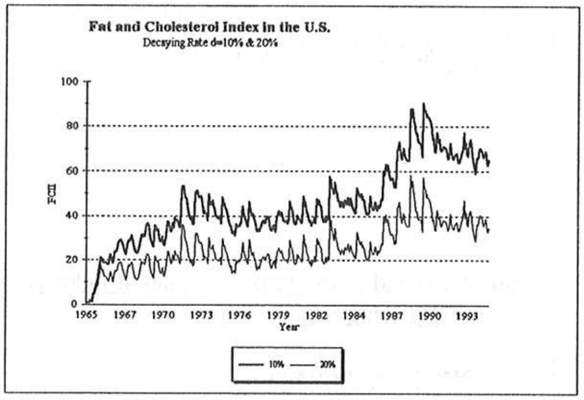
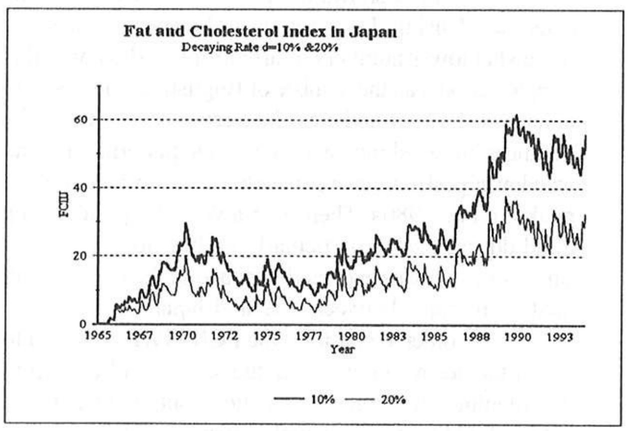


Figure 4 shows two FCII-GWF indexes constructed for Japan. Similar to the U.S. indexes, the higher decay rate results in a lower magnitude of the index. The two curves are parallel to each other over time, indicating they are reflecting a similar trend. The highest peaks occurred in late 1980s, with the lower curve (d = 20%) reaching the highest peak somewhat earlier than the upper curve (d = 10%).

Figure 4. Fat and Cholesterol Information Indexes (FCII-GWF) in Japan



For analyzing the changing patterns of the health information between the U.S. and Japan, a simple model regressing the logarithm of the indexes on the time trend variable is estimated. The time coefficient can be interpreted as the average growth rate of the consumer health information about fat and cholesterol. The results presented in Table 1 show that the FCII-GWF indexes are less correlated with time and yield higher growth rates than the FCII-CWF. Furthermore, the estimated growth rates from Japanese indexes are considerably higher than those estimated from the U.S. (English) indexes.

These findings indicate that the consumers in Japan may have increased their health information about fat and cholesterol at a more rapid rate than the U.S. consumers. However, it is not appropriate to claim that Japanese consumers are more health conscious than U.S. consumers because the U.S. indexes have higher magnitudes because the numbers of English articles were larger than Japanese articles. Also, the slightly different key words were used to identify the relevant articles in the two data sets.

Table 1: Estimated Growth Rate of Health Risk Information on Fat and Cholesterol.

		U.S.		Japan	
Index	Specification	Time Coefficient*		Time Coefficient*	
FCII -CWF	m=12 & n=2	0.0398	0.72	0.0572	0.71
FCII -GWF	d=10%	0.0476	0.63	0.0794	0.60
	d=20%	0.0428	0.68	0.0741	0.61

* All Coefficients of time variable are statistically significant at the one percent level

Further Validation

Whether or not the indexes developed in this study measured accurately the historical trends of consumer information on fat and cholesterol is difficult to verify. Note that both FCII-CWF and FCII-GWF indexes show that the consumer information actually declined in recent years. It may appear counter intuitive to the general belief that consumers in the U.S. or Japan should always become more knowledgeable about fat and cholesterol. However, if we accept the hypothesis that information from published articles should have a finite duration and decaying effects as a source of information, then one should not be surprised to see the declining trends of those indexes in recent years.

We examined the trends of fat and oil consumption for 1965-1994 in the U.S. and Japan, and found that the substitution patterns between vegetable oils and animal fats appear to be consistent with the historical trends of health information measured by both FCII-CWF and FCII-GWF indexes. In particular, there was a reversal of the declining trend in animal fat consumption in 1991 in both countries.

To formally test the validity of the indexes constructed in this study, we will need to examine their explanatory power in a demand system for such foods with high content of fat. This is the subject for further study in the future.

Conclusions

This paper presents alternative indexes for measuring the consumer's health risk information on fat and cholesterol. The methodology extends the existing indexes to provide a more flexible functional form in specifying the decay effects of information sources. These indexes were constructed for the U.S. and Japan based on the numbers of English and Japanese articles related to fat and cholesterol published in medical journals.

The results show that the information indexes incorporating the carry-over and decay effects exhibit strikingly different historical patterns of consumer health information than either the time trend or the information index simply accumulating the numbers of published relevant articles. Both the FCII-CWF (with a cubic weight function) and FCII-GWF (with a geometrically declining weight function) exhibit a similar pattern of changes in consumer health information about fat and cholesterol. They all indicate that the consumer information peaked in the late 1980s and declined in recent years. These trends of consumer information actually match very closely with the consumption trends of fats and oils in Japan and the U.S.

The comparison of the indexes between Japan and the U.S. shows that the rate of increase in health information has been higher in Japan than in the U.S. While there are many evidences regarding the impacts of health concerns on consumer demands for such foods as fats and oils, or red meats in the U.S., the existence of such impacts in Japan has yet to be investigated.

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Endnote

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